

JPRS 68600

8 February 1977

U S S R

EAST  
EUROPE

USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS  
GEOPHYSICS, ASTRONOMY AND SPACE  
No. 390

**DISTRIBUTION STATEMENT A**  
Approved for Public Release  
Distribution Unlimited

20000215 068

U. S. JOINT PUBLICATIONS RESEARCH SERVICE

Reproduced From  
Best Available Copy

#### NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

#### PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22151. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Indexes to this report (by keyword, author, personal names, title and series) are available through Bell & Howell, Old Mansfield Road, Wooster, Ohio, 44691.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

<b>BIBLIOGRAPHIC DATA SHEET</b>	1. Report No. <b>JPRS 68600</b>	2.	3. Recipient's Accession No.
4. Title and Subtitle <b>USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS - GEOPHYSICS, ASTRONOMY AND SPACE, No. 390</b>		5. Report Date <b>8 February 1977</b>	
7. Author(s)		6.	
9. Performing Organization Name and Address <b>Joint Publications Research Service 1000 North Glebe Road Arlington, Virginia 22201</b>		8. Performing Organization Repr. No.	
10. Project/Task/Work Unit No.		11. Contract/Grant No.	
12. Sponsoring Organization Name and Address  <b>As above</b>		13. Type of Report & Period Covered	
14.		15. Supplementary Notes	
16. Abstracts  The report contains abstracts and news items on meteorology, oceanography, upper atmosphere and space research, astronomy and terrestrial physics, covering both science news and formal scientific reports. Published details of Soviet space spectacles are included.			
17. Key Words and Document Analysis. 17a. Descriptors  USSR Geophysics Astronomy Astronautics Meteorology Oceanography			
17b. Identifiers/Open-Ended Terms			
17c. COSATI Field/Group 3, 4A, 4B, 8, 22			
18. Availability Statement <b>Unlimited Availability Sold by NTIS Springfield, Virginia 22151</b>		19. Security Class (This Report) <b>UNCLASSIFIED</b>	21. No. of Pages <b>61</b>
		20. Security Class (This Page) <b>UNCLASSIFIED</b>	22. Price

# USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

## GEOPHYSICS, ASTRONOMY AND SPACE

No. 390

This serial publication contains abstracts of articles from USSR and Eastern Europe scientific and technical journals on the specific subjects reflected in the table of contents.

Photoduplications of foreign-language sources may be obtained from the Photoduplication Service, Library of Congress, Washington, D. C. 20540. Requests should provide adequate identification both as to the source and the individual article(s) desired.

	CONTENTS	PAGE
I.	ASTRONOMY.....	1
	News.....	1
	TASS Announces Operation of "Gorizont" Complex at Gissar Observatory	1
	New Neutrino Astronomy Observatory Being Established.....	1
	Abstracts of Scientific Articles.....	3
	Gravitational Field of Saturn's Rings.....	4
	Mechanism of Mass Escape from Sun in Transient Phenomena.....	4
	Special Case of Type-II Solar Radio Bursts.....	5
	Solar Microwave Bursts With Quasithermal Spectrum.....	5
II.	METEOROLOGY.....	7
	News.....	7
	Report of Artificial Precipitation Production Project of International Meteorological Organization.....	7

	<u>Page</u>
Report on Oceanic Station "S" in North Atlantic.....	9
III. OCEANOGRAPHY.....	12
News.....	12
New Research Ship to be Built for Arctic.....	12
Notes on Pacific Ocean Expeditions of the Sakhalin Multidiscipline Scientific Research Institute.....	14
Sakhalin Scientists Study Ocean Sounds.....	15
Astronomical Phenomena Proposed to Explain Bermuda Triangle....	16
Academician Brekhovskikh Comments on Bermuda Triangle.....	18
Abstracts of Scientific Articles.....	20
Temperature Field of Surface Layer in Tropics.....	20
Large-Scale Eddy Formations in Ocean.....	21
Dissipation of Kinetic Energy in Ocean.....	22
Prediction of Anomalous Gravity Field in Pacific Ocean.....	22
Hamiltonian Formalism for Stratified Media.....	23
Reaction of Stratified Ocean to Typhoon.....	24
Effect of Currents on Sea Magnetotelluric Research.....	24
Analysis of Gravimagnetic Waves.....	25
Review of Ocean Acoustics.....	25
IV. TERRESTRIAL GEOPHYSICS.....	26
Abstracts of Scientific Articles.....	26
Seismic Waves in Inhomogeneous Media.....	26
Acoustic Modeling in Deep Seismic Sounding.....	26
Formation of Crust in Northwestern Pacific Ocean.....	27
Gravity Anomalies and Their Geological Nature.....	28

	<u>Page</u>
Anomalous Magnetic Field in Pacific Ocean Mobile Zone.....	28
Method for Solving Inverse Problems in Gravimetric Prospecting..	29
Layers With Reduced Velocity in Crust of Southern Turkmenistan..	30
Method for Computing Gravitational Field of Three-Dimensional Masses.....	30
Effect of Sea Tides on Earth Tides.....	31
Theory of Thermogravitational Changes in Earth's Volume.....	31
Magnetotelluric-Magnetovariation Studies in Ciscaucasia.....	32
V. UPPER ATMOSPHERE AND SPACE RESEARCH.....	33
News.....	33
Interview with Cosmonaut Sevast'yanov.....	33
"Morsvyaz'sputnik Association Formed for Marine Satellite Communications.....	37
Central Television Introduces New System for Remote Areas.....	38
Beregovoy Comments on Preparations for Joint Experiments in Space.....	39
Abstracts of Scientific Articles.....	40
Two-Frequency Radio Probing of Venusian Ionosphere.....	40
Theoretical Model of Ionospheric Balance Equation.....	41
Formation of High-Latitude Ionosphere.....	41
Registry of Geomagnetic Pulsations in Soviet-German Experiment..	42
Findings of Night Airglow of Venus.....	42
Scattered Lyman-Alpha Radiation Around Venus.....	43
Improved Method for Determining Coordinates of Artificial Satellites.....	44
Transfer of Energy of Internal Waves to Mean Flow.....	44

	<u>Page</u>
Orbital Behavior of Balloon Satellites Under Influence of Light Pressure.....	45
Interplanetary Background of Low-Energy Charged Particles.....	46
Cosmic Ray Measurements Aboard "Venera" Vehicles.....	46
Television Experiment on Venusian Surface.....	47
Venusian Infrared Spectrum.....	48
Problems of the Polar Ionosphere.....	48
Energy-Modulation Coefficient Dependence in 11-Year Cycle.....	49
Method for Determining N(h) Profiles for Ionosphere.....	50
Contrast of Negative Relief Forms on Venusian Surface.....	50
Automatic Determination-Detection of Collimating Marks on Photographs.....	51
VI. MISCELLANEOUS.....	53
News.....	53
Work of Laboratories at Arctic and Antarctic Institute.....	53
Special Drilling Apparatus Pierces Antarctic Ice Shelf.....	54
"Bashkiriya" Under Way to the Antarctic.....	54

## I. ASTRONOMY

### News

#### TASS ANNOUNCES OPERATION OF "GORIZONT" COMPLEX AT GISSAR OBSERVATORY

Moscow IZVESTIYA in Russian 24 Dec 76 p 4

[TASS Report]

[Text] Tadzhik SSR. A new scientific complex, the "Gorizont" of the ionospheric laboratory of the Tadzhik Academy of Sciences' Institute of Astrophysics, has begun operation at the Gissar Astronomical Observatory.

A photograph shows a high-precision astronomical installation (VAU) which is a satellite camera used to photograph artificial earth satellites and very faint meteors. [5]

#### NEW NEUTRINO ASTRONOMY OBSERVATORY BEING ESTABLISHED

Moscow ZNANIYE-SILA in Russian No 11, 1976 pp 12-14

[Article by A. Vekhov, "From Here They Glance into the Sun's Interior"]

[Abstract] A unique scientific structure, a neutrino telescope, is being constructed 15 kilometers from Mount Cheget. The article describes the progress in constructing the station: laboratory building, auxiliary buildings and opposite the tunnel, the most important structure of all, the cottages of the future settlement of Neutrino. In registering the main flux of solar neutrinos, which at the earth is  $6 \cdot 10^{10}$  particles per  $\text{cm}^2$  per second, it is best to use a different detector, a gallium detector, which has been developed by the Soviet physicist V. A. Kuz'min. The gallium detector, for intercepting neutrinos with an energy of 235 keV or above, can be transformed into radioactive germanium under such conditions. The decay of the forming germanium can be registered by a special instrument. Due to the small probability of interception of neutrinos the detector should preferably have a great mass of gallium (20 tons). Fortunately, it is not necessary to have pure gallium; it is entirely adequate to have a solution of gallium

chloride in HCl. And it is simpler to separate germanium from a fluid. In this complex process it is necessary to screen out the background effects -- from cosmic rays, the earth's natural radiation and from the instruments themselves. For protection against cosmic rays the entire complex is hidden deep underground. Concrete and metal are also used in creating low-background chambers. The chief of this new neutrino station is Candidate of Physical and Mathematical Sciences Aleksandr Pomanskiy. The tunnel, he reports, has now been driven two kilometers of the planned four into the side of Andyrchi Mountain. The main apparatus is to be placed at the very end of the tunnel, but the gallium detector itself is to be placed at the midpoint in the tunnel. In this same tunnel, under the direction of A. Ye. Chudakov, specialists are constructing still another grandiose structure -- an apparatus for the study of neutrinos of a different nature, cosmic and atmospheric.

[151]

### Abstracts of Scientific Articles

#### OPTICAL ANALYSIS OF CHEMICAL COMPOSITION OF LUNAR SURFACE

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 10, No 4, 1976 pp 177-189

[Article by N. N. Yevsyukov, Khar'kov State University, "Experience in Remote Optical Analysis of the Chemical Composition of the Lunar Surface"]

[Abstract] This paper is devoted to a refinement of interpretation of the optical characteristics of the moon and on this basis, computation of the chemical composition of rocks in different regions, and also establishing correlations between the optical types of surface and types of lunar rocks. Computations were made for approximately 140 analyses of rocks, including crystalline rocks, breccias and the fine fraction. The chemical composition of rocks was represented in two variants -- the weight content of oxides and a set of geochemical parameters in the classification of rocks developed by A. N. Zavaritskiy. The use of these variants gives two models of remote optical analysis of the composition of the lunar surface. For the greater part of the surface the two models give close results; discrepancies are noted only for regions with extremal properties. This requires an unambiguous choice of the interpretation variant, for which at the present time there is no adequate basis. Accordingly, the study gives two computation models; the two representations of the composition supplement another in a geochemical interpretation of the different relationships among the chemical components. There is shown to be a correlation between optical regionalization of the moon and regionalization on the basis of chemical properties. Attention is given to the complexity of remote determination of the chemical composition of regions with an albedo of  $\sim 0.18$  and also regions with the highest color index.

[147]

## GRAVITATIONAL FIELD OF SATURN'S RINGS

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 10, No 4, 1976 pp 218-221

[Article by A. M. Bobrov, V. P. Trubitsyn and Ya. A. Lev, Institute of Physics of the Earth, "Gravitational Fields of Saturn's Rings"]

[Abstract] The gravitational field of Saturn's rings is estimated in the example of a simplified model of a homogeneous disk. In the model there are four rings A, B, C, D, separated by narrow slots and filling the region from the planetary surface to the outer edge of ring A with a radius of 139,000 km. The rings probably consist of particles of ice measuring 1 cm to 1 km. The total mass of the rings  $M_1$  is about  $10^{-4}$ - $10^{-6}$  of Saturn's mass  $M_0$ . The thickness of the rings is 1-4 km. It is shown that the moments of the rings  $j_k$  and the corrections to the total field  $\Delta J_k$  for a fixed mass  $M_1$  are not dependent on the thickness  $h$  of the rings. The  $j_k$  and  $\Delta J_k$  values are slightly dependent on the form of the rings. The greatest uncertainty in the data on the rings relates to their mass  $M_1$ . A new possibility of determining the mass of Saturn's rings will be afforded using data from impending fly-by and satellite measurements of the total field of Saturn. The higher harmonics of ring potential exceed the corresponding harmonics of the planet for  $n > 6-8$ . This indicates the possibility of determining the mass of the rings using measurement data for the total outer field of Saturn.

[147]

## MECHANISM OF MASS ESCAPE FROM SUN IN TRANSIENT PHENOMENA

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 53, No 6, 1976, pp 1264-1269

[Article by A. M. Uralov and V. V. Kasinskiy, Siberian Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation Siberian Division USSR Academy of Sciences, "On the Problem of the Mechanism of Mass Escape from the Sun in Transient Phenomena"]

[Abstract] Recently observations aboard the Skylab revealed moving disturbances in the corona with a velocity of 200-1,000 km/sec at distances 1.5-6  $R_\odot$ . These so-called transient phenomena are accompanied by great (up to  $10^{16}$  g) losses of mass and cause interplanetary shock waves at a distance of 1 a.u. Most of the "transients" correlate with such phenomena in the optical range as eruptive prominences and strong flares accompanied by surges. In the paper cited above the authors propose a mechanism for explaining these so-called transients in the corona. The transients, eruptive prominences and chromospheric surges (of the "spray" type) are considered to be a result of successive passage of a shock wave through sharply inhomogeneous jumps in the solar atmosphere: chromosphere-corona, prominence-corona. The computations given in the paper make it possible to interpret the observed

peculiarities of the transients. The case of a surge prominence is more probable in the considered model in accordance with the observations reported by Stuhlinger, Munro, et al., and Gosling, et al.  
[163]

#### SPECIAL CASE OF TYPE-II SOLAR RADIO BURSTS

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 53, 1976, No 6, pp 1254-1259

[Article by A. K. Markeyev, V. V. Fomichev and I. M. Chertok, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, "Type II Solar Radio Bursts with Reverse Frequency Drift"]

[Abstract] The dynamic spectra of type-II radio bursts of 21 and 23 December 1970 recorded with the spectrograph of the Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation (45-90 MHz) are analyzed. The drift of radio emission from the low to the high frequencies is the main feature of the bursts. It is suggested that such bursts were generated by shock waves which appeared as a result of flarelike processes in the coronal neutral current layer and initially propagated toward the solar surface. The observed phenomena evidently indicate that in the neutral current layer localized high in the corona there are processes similar to chromospheric flares and leading to the appearance of shock waves. These shock waves experience considerable refraction during propagation in the direction of the solar surface. It is emphasized that such bursts are observed extremely rarely and these processes in coronal current layers probably occur only in exceptional cases.  
[163]

#### SOLAR MICROWAVE BURSTS WITH QUASITHERMAL SPECTRUM

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 53, No 5, 1976 pp 1041-1045

[Article by A. M. Uralov and V. P. Nefed'yev, Siberian Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, "On the Nature of Solar Microwave Pulse Bursts with a Quasithermal Spectrum"]

[Abstract] The heat released during a chromospheric flare is transported upward by a shock (or thermal) wave. When the shock front of the expanding hot region reaches the layers where  $\tau \sim 1$ , a radio burst is formed. Absorption due to free-free transitions is assumed to be dominant. Within the framework of the adopted thermal model presented in this paper, there is a clear correlation between centimeter bursts and bursts in the soft x-ray region. Since the solar atmosphere is transparent in the x-ray region, the burst in the x-ray region begins earlier than a burst in the radio range

and will correspond to the "onset" of an explosive flare. The flux maximum in the soft x-region will be attained when the burst in the radio range is completed. The further decline of the burst is completely determined by relaxation processes. In this case radiation in the soft x-region is interpreted as purely thermal in the region with  $T \gtrsim 10^7$  K,  $n \lesssim 10^{10}$  cm<sup>-3</sup>. The presence of extremely hot regions after a flare ( $T \approx 2 \cdot 10^7$  K,  $n \approx 5 \cdot 10^{10}$  cm<sup>3</sup>) is also confirmed by observations in the line Fe XXIV.

[119]

## II. METEOROLOGY

### News

#### REPORT OF ARTIFICIAL PRECIPITATION PRODUCTION PROJECT OF INTERNATIONAL METEOROLOGICAL ORGANIZATION

Moscow IZVESTIYA in Russian 10 Dec 76 p 4

[Article by V. Shmyganovskiy: "Designers of World"]

[Text] A telegram is received at the Artificial Modification Administration of the USSR Main Administration of the Hydrometeorological Service: "Fog has been cleared from the Dnepropetrovsk and Zaporozh'ye airports. Forty aircraft have landed and taken off..."

\*\*\*

Such communications are now becoming more and more common, as is news of the successful results of protection of agricultural crops against the falling of hail, artificial inducing of precipitation and even... the breaking up of clouds (such an experiment was recently carried out in Moldavia). The meteorologists and other specialists are formulating a program for artificially inducing precipitation in the region of Lake Sevan. For this purpose specialists are planning a scientific polygon outfitted with radar apparatus, aerosol generators, meteotron, etc. This kind of work in our country and abroad is of enormous importance for all the peoples living on our planet.

Unstable weather and droughts affecting even countries which usually have a moist climate (we will mention only the present hot summer in Great Britain), all this has resulted in a boom in developing new methods and apparatus for inducing artificial precipitation with the use of surface and air generators, with the use of different chemical substances.

In some regions of the United States, every few miles it is possible to see sprayers with cylinders. These are generators for the artificial modification of clouds which "breathe" silver iodide by command from a control panel. Penetrating into the supercooled layers of clouds, it forms numerous ice crystals. In this case specialists are making use of the phase

instability of supercooled clouds, which not only favors the formation of precipitation particles, but also the transformation of a great quantity of latent heat. The ice particles obtained by means of the "seeding" with ice-forming aerosols, multiplying, are transformed into precipitation particles. In these studies, together with silver iodide, use is made of dry ice -- solid carbon dioxide.

The artificial rain technique is being tested in our country, especially in a polygon near Dnepropetrovsk, as well as in a number of other highly developed countries. It is well known, however, that particularly severe natural misfortunes occur most frequently in the developing countries of Asia, Africa and Latin America. Most of the countries do not have either scientific or practical experience in contending with the murderous curse of fields and plantations -- drought. Many of these countries have repeatedly turned to the World Meteorological Organization (WMO) with requests that they be assisted in organizing work on artificially producing additional precipitation.

The executive committee of the WMO in its 24th session adopted a resolution calling for the forming, from among well-known scientists, a working group on cloud physics and weather modification in the Commission on Atmospheric Sciences. At this same session specialists noted the general principles of consultation and assistance in the planning of activity on the transformation of weather.

At the seventh WMO congress it was decided to establish an international "Project for Increasing Precipitation." For directing this project an administration was established which at its first session approved its plan, which it is intended to implement up to 1987.

The Soviet scientist Candidate of Physical and Mathematical Sciences I. I. Burtsev was elected vice president of the administration. (In Moscow he heads the above-mentioned artificial modification administration.)

"There is an enormous amount of work to do," says Ivan Ivanovich. "In particular, this involves the choice of a polygon for the investigations. At a conference in Geneva, where the WMO headquarters is located, it was possible to determine its extent -- 50,000 square kilometers with an active zone equal to one-fifth of this area. After the project is completed plans call for making some recommendations on application of the method tested during its execution."

"In what part of the earth was it decided to locate the polygon?"

"Initially sixteen countries proposed their services. After making a preliminary expert evaluation, six of them remained: Algeria, Argentina, India, Spain, Mexico and Tunisia. A group of experts, including a Soviet representative, has already visited Algeria, Spain and Tunisia."

"What was involved in choosing the place for carrying out the experiment?"

"Many details are involved here. It is necessary to find a region constituting a sort of 'golden mean' from the point of view of climatic conditions. Preference is given to a territory in which the mean annual quantity of precipitation is 500-700 mm and falls over the course of 3-5 months. It should be suitable for a precise scientific evaluation of the results of experiments for increasing precipitation. One must be sure that a certain quantity of precipitation over a period of five years of observations is not random but is associated precisely with the 'seeding' of clouds. It is very important to study the distribution of precipitation in the zone adjacent to the active polygon..."

"The authors of the project propose in this way to solve major scientific and practical problems. Carefulness in the choice of the territory and the representativeness of the composition of the participants explains the diversified nature of the experiment."

"The planned project is only part of the extensive WMO measures. It is very important that all these investigations have an international character: after all, we live on a planet whose atmosphere does not recognize national boundaries."

[164]

#### REPORT ON OCEANIC STATION "S" IN NORTH ATLANTIC

Moscow IZVESTIYA in Russian 2 Dec 76 p 6

[Article by V. Vodolazhskiy: "Area 'S' in the Ocean"]

[Text] "Have taken over complete servicing of oceanic station 'S' from weather ship 'Passat' at 2000 GMT -- Captain Skornyakov."

Such a radiogram was received in Moscow at the State Oceanographic Institute. Then came a communication from the 'Passat': "Turned over to the scientific research weather ship 'Musson' complete servicing of oceanic station 'S'. Captain Stepanov."

Two radiograms, and both of them mention oceanic station "S". Where is it situated, what is its significance, and exactly why do weather ships keep watch there?

"It is located in the North Atlantic approximately 800 miles to the east of Newfoundland," says the director of the expeditionary work group of the State Oceanographic Institute V. Shirayev. "Its coordinates are 52°45'

N, 35°30'W. This point is in the distant Atlantic, an arbitrarily delimited 10-mile square and called oceanic station 'S.' Here the weather ships work all year round."

"This region was selected by scientists for investigations and observations after careful thought. Powerful cyclones are generated precisely at these latitudes. And at the same time the busiest ocean routes are located precisely here."

"The principal task of the work of the scientific research ships of the countries participating in OSNA (oceanic stations in the North Atlantic) is ensuring continuous observation of hydrometeorological conditions in the regions of the stations. They warn seamen about the most dangerous phenomena in the ocean: the appearance of storms, dangerous wave heights, presence of icebergs. They prepare recommendations on the safest courses for navigators."

"Does that mean that our station is not the only one in the North Atlantic?"

"In addition to the Soviet station, there are three others. Station 'L,' serviced by the scientific ships of Great Britain, 'M,' serviced by the Netherlands, Norway and Sweden, and 'R' by France. All the information and the results of the investigations are regularly transmitted from them to the British data processing center at Bracknell, as well as to the hydrometeorological centers and other scientific institutes of the country-participants in the agreement. Incidentally, the agreement was concluded in 1975. Soviet specialists have been carrying out work at the station since 1 July 1975. Since that time our ships have already made 25 voyages to that point. Twelve of them each year."

"What is the duration of these voyages?"

"The scientific expeditions are at sea for 70-90 days and directly in the region of point 'S' for a calendar month, after which the watch is handed over to another ship. Now the 'Musson' has taken over from the 'Passat.' It will be replaced by the scientific weather ship 'Viktor Bugayev'."

"It is interesting. What is the weather now at oceanic station 'S'?"

"We have just received a radiogram from the 'Musson': 'Wind scale 5, waves at sea five scale units.' The weather at times, it can be said, truly makes it difficult for sailors and scientists. The 'Passat' has already had to contend with the weather. For example, early in November it had to contend with a wind of 10 scale units. Waves at sea have attained up to nine scale units. In such a storm the height of the waves at times attained 12 meters! Under these complex conditions the expedition acted reliably and without hesitation. And on the eve of change in duty ships

the 'Passat' came to the assistance of the sinking Turkish vessel 'Zeki,' taking aboard 27 Turkish sailors. Now the 'Passat' is enroute to its native shores. On 3 December it will enter Genoa and on 11 December it will return with joy to Odessa."

[142]

### III. OCEANOGRAPHY

#### News

#### NEW RESEARCH SHIP TO BE BUILT FOR ARCTIC

Moscow PRAVDA in Russian 10 Dec 76 p 6

[Article by A. Androshin: "An Icebreaker Like None Before"]

[Text] Scientists have dreamed about such an expeditionary ship for a long time, although the polar fleet during recent years has been well supplemented. Together with the "Lenin" icebreaker, a work watch is today being kept by other heroes: "Arktika," "Krasin," "Yermak"... Using them it was possible to prolong the navigation season on the Northern Sea Route and in the freezing ports.

The Deputy Chief of the USSR Hydrometeorological Service Ye. I. Tolstikov stated: "But the people who are studying this remote region want more: a considerable broadening of multisided studies in the waters of the inaccessible and poorly studied polar regions. It is also important to broaden significantly and supplement the information arriving from shore and drifting stations. A scientific research icebreaker will make it possible to implement these plans. It is noteworthy that it is called the 'Otto Schmidt' in honor of the outstanding Soviet polar worker whose name is inseparably associated with the mastery of the arctic regions."

Let us imagine that we are aboard the new icebreaker. The first impression is: is this a ship in the ordinary sense? It is very dissimilar from its "fellows." One is surprised by the numerous laboratories: oceanographic, meteorological, ice research... There will be a total of 14. The icebreaker is a singular floating unit of the Arctic and Antarctic Scientific Research Institute. The designers worked on the design of the ship, taking into account the proposals and requirements of polar workers. For example, the icebreaker has no prow screw and stability during movement in the open water is improved due to antirolling apparatus.

The power of the diesel-electric engine of this ship is 5,400 HP, the displacement is 3,650 tons, the sailing range without visiting ports is 11,000 miles. For supplementing the supplies of water provision is made for a freshening apparatus. Tests of the ship model revealed that it is capable of overcoming ice fields with a thickness of sixty centimeters at a speed of about two knots.

Scientists and specialists in the course of a voyage can carry out observations under different aspects of the scientific program: hydrochemistry, hydrology, oceanology, meteorology and hydrography. They will study the interaction between the ocean and the atmosphere. Is it necessary to investigate the underwater world? Provision is also made for that. The "Otto Shmidt" has a room for aqualungists. Is it necessary to measure solar radiation? On the icebreaker there is an original extensible apparatus resembling a boom which makes it possible to extend the apparatus for a distance as great as eight meters in front of the stem. And for work with ice samples there is a so-called "cold" laboratory where a constant sub-zero temperature is established and maintained.

In continuing familiarization with the future icebreaker, we enter into the conference hall. It is outfitted with apparatus for the synchronous transmission of reports in a number of foreign languages.

A computation center has been created in one of the compartments of the "floating institute." Plans call for the information collected on the voyage to be processed by means of an electronic computer carried aboard.

There it is, the "Otto Shmidt," the leader of the Soviet scientific icebreaker fleet, which will make possible a considerable broadening of the times and regions for investigation of the northern seas. This in turn will serve to the advantage of the further complex study of the world ocean.

One last question remains to answer: when will the new icebreaker enter into service?

Ye. I. Tolstikov states: "An agreement about its construction has already been signed between the USSR Hydrometeorological Service and the Leningrad Admiralty Combine. The home port of the icebreaker will be Murmansk. The "Otto Shmidt" will be sent there in 1978 for a voyage through the northern seas. I would like to add that this will be the world's first ship of such a type.

[155]

NOTES ON PACIFIC OCEAN EXPEDITIONS OF THE SAKHALIN MULTIDISCIPLINE  
SCIENTIFIC RESEARCH INSTITUTE

Moscow IZVESTIYA in Russian 4 Dec 76 p 6

[Article by B. Prokhorov: "How the Ocean Was Born"]

[Excerpt] Our scientists are devoting great attention to investigation of the mysteries of the world ocean. In the first year of the Tenth Five Year Plan the scientists of the Sakhalin Complex Scientific Research Institute have carried out several interesting expeditions in regions of the Pacific Ocean.

Under direction of Professor I. Tuyezov, Doctor of Geological-Mineralogical Sciences, one of these expeditions has been concerned with study of the submarine Marcus-Necker Ridge, which is situated between the Hawaiian Islands and the Marianas abyssal trench. Was the ridge once land or was it always under the waves? The Marcus has revealed its secrets. It has been established that the thickness of the sedimentary rocks on the slopes of the ridge is unusually great -- up to 1,400 m, whereas this value usually attains only 200-400. The seismic waves reflected from the ocean floor over the Marcus were returned to the instruments after three seconds instead of the expected tenths of a second. This means that scientists were able to probe deeper rocks than was achieved earlier in such investigations. And still another secret of the underwater ridge. There is a theory according to which the magnetic pole of the planet has frequently changed its sign to the opposite! The north pole has moved to the site of the south pole, and vice versa. These movements were recorded by some magnetic minerals. According to data from Sakhalin scientists, the Marcus magnetic field creates the impression that the formation of its volcanic rocks occurred precisely during the period when the poles changed place.

Another expedition carried out a complex survey of the Kurile-Kamchatkan trench. An enormous region of the ocean was studied. A dredge was lowered to the ocean floor three hundred times for the collection of samples, at times to a depth of nine kilometers. An interesting discovery was made. For example, there are almost no sediments on the trench floor: this gives basis for assuming that the gigantic fissure on the ocean floor is quite young on geological (of course) scales.

The investigations of the depths of the Pacific Ocean depression, in addition to theoretical conclusions, also have practical value because they assist in an understanding of the processes of formation and the patterns of distribution of mineral deposits.

[157]

## SAKHALIN SCIENTISTS STUDY OCEAN SOUNDS

Moscow IZVESTIYA in Russian 12 Dec 76 p 4

[Article by Yu. Shashkov: "The Voice of the Ocean Sound"]

[Text] A slight turning of a switch and the room is filled with a sound symphony unusual for the human ear. What can it be compared with? Visualize that all terrestrial sounds from the whistling of a jet turbine to the rustling of leaves are on the same par and that the concepts "loud" and "quiet" no longer exist and that there is one even murmur of hundreds of voices. Such is the "conversation" of the inhabitants of the seas and oceans.

"Now," states V. Apanasenko, head of the laboratory of sound propagation in the sea of the Sakhalin Multidiscipline Scientific Research Institute, "we have heard records collected on the ocean floor. It is only possible to guess to whom each of these individual voices belongs. Scientists are only getting down to their recognition, much less their classification. This is a complex matter if it is taken into account that more than 150,000 species of animals live in the world ocean, including 16,000 species of fish."

The laboratory specialists have formulated the objective of "calibrating" these voices, breaking them down by all frequencies in the first stage of study of ocean noise. The scientists are trying to determine the threshold beyond which everything merges into a single background.

The noise threshold. Again it is necessary to have recourse to terrestrial comparisons. Let's say that in the howl of an enormous stadium it is important to distinguish the voice of a single person in the opponent's stands. If you can recognize the voice of each one well, then you can distinguish the voice of a single person. Here this is done by a special instrument which "screens out" everything which is unnecessary.

"It is simplest to register a signal as is done in motion pictures, on a sound track," states scientific specialist V. Kalinovskiy. "But in this case we obtain only a precise videocopy of a chaos of voices registered on magnetic tape. But you must hear each sound individually. That is why before taking a sound from the oscillograph and putting it on photographic film it must be passed through a singular purifier -- an analyzer. Each characteristic sound finds its place in the frequency band, seemingly fitting into the personal band, the segment of the photofilm allocated only to it. Whose this voice is for the time being is unknown, but having a set of voices, seemingly broken down by little bands, it is possible to hand over this collection to scientists directly observing life in the world ocean. They will assist in determining the 'soloists'."

Solution of the problem can also have purely practical importance. Let us assume that we already have a record of the voices belonging only to predator fish. Then in principle it is possible to construct an apparatus which can be used in studying these sounds. For example, not far from a trawl used in the taking of commercial fish.

However, they say that fish are poor students. But such experiments are also of purely practical importance.

Not so long ago the famed French oceanologist Jacques Ives Cousteau rose up against the centuries-old concept of a "world of silence" of the ocean depths. Now it is clear to specialists that the world ocean in its wealth and diversity of voices can compete with the land and it is still unknown who will be the victor.

[143]

#### ASTRONOMICAL PHENOMENA PROPOSED TO EXPLAIN BERMUDA TRIANGLE

Moscow IZVESTIYA in Russian 5 Dec 76 p 4

[Article by V. Zakhar'ko: "When the Moon is in Perigee"]

[Text] No one knows how many catastrophes have occurred in the region of the Atlantic Ocean between the Bermudas, Florida and Puerto Rico, but we know that there have been a great many. We will pass over the frightening details exciting the imagination; they have been described in detail in the literature devoted to the "Bermuda" mystery. We will recall only a few of the hundreds of facts which up to today have not received convincing interpretations.

On 5 December 1945, during ideal weather, squadron 19, consisting of five torpedo bombers under the command of Lt. Charles Taylor, took off from the American base at Fort Lauderdale in the state of Florida. Sixty-five minutes later the base air control officer heard an alarming communication from C. Taylor: "...We are on the brink of a catastrophe...It seems that we have been knocked off course..."

A naval seaplane took off for finding those who had experienced catastrophe. But communication with it was soon interrupted. Since 1945 more than a hundred large and small ships and about 20 aircraft have been lost in the Bermuda Triangle.

But this is not the only place where such incomprehensible events have been noted. In the region between Japan, Guam and the Philippines so many ships and aircraft have disappeared without news that the Japanese government has officially declared it a danger zone.

The opinion prevails that the "triangles" have no secrets, that everything occurring in them is the result of the inexperience and errors of navigators and pilots, and not the action of any natural forces. But this point of view has not been thoroughly demonstrated. There is no doubt but that sooner or later the truth will be established. But for the time being these regions are being carefully studied both from the sea and from the air, from space, in offices and in the laboratories of scientists. A timely and interesting hypothesis is that recently advanced by A. I. Yel'kin, Doctor of Physical and Mathematical Sciences, head of a department at the Moscow Civil Engineering Institute.

"I do not want to dwell," said A. Yel'kin to me, "on any of the points of view concerning the 'triangles': is there a scientific problem here or not? I simply assumed that the problem exists and tried to clarify whether there was any pattern in the catastrophes."

"After collecting statistics on aircraft, I saw that the moments of their disappearance (in contrast to ships they are established with an accuracy to a day) have a definite pattern, related to astronomical phenomena. To be more exact, there is a relationship of the earth, moon and sun relative to one another."

"It is well known that our small space home, the earth, whirls in world space in a very complex trajectory, participating in many mechanical movements. As a result of this, there can be a continuous change in the coordinates of the earth relative to the sun and moon, which in turn also do not stand in place. As a result, the sun and moon do not always exert an identical influence on the earth."

"Since the earth is flattened at the poles, the sun and moon strongly attract that part of it at the equator which is closest to it. This gives rise to so-called precessional forces seemingly tending to turn the earth's axis of rotation. These forces are of the greatest importance in December and June and are zero in March and September. In addition to precessional forces, acting on our planet by the sun and the moon, there are tide-generating forces which somewhat change the figure of the earth. Their intensity and direction are also not constant. They are maximum at the times of the new moon and the full moon. Revolving around the earth in an elliptical orbit, the moon first approaches us and then withdraws. When it is closest to the earth (at perigee), its tide-generating force is 40% greater than at apogee."

"By knowing from statistics when aircraft disappeared without a trace, I established what coordinates the sun and moon occupied on these days. Without now penetrating into all the details of this question, I will speak about the most important thing: it was found that the moments of air catastrophes fit into a definite pattern--they coincide with the time of the

new moon or the full moon and the position of the moon near perigee, and also with the times of the greatest precessional forces."

"The discovered pattern makes it possible to postulate that at such moments in the region of the 'Bermuda' and other triangles lunar-solar tides can cause the movement of ionized magma beneath the ocean floor and it generates magnetic anomalies. Under the conditions created in this case there can be a malfunctioning of ordinary and gyrocompasses, clocks and electric and electronic instruments, as occurred on aircraft and on ships. And this could be one of the reasons for catastrophes."

"A hypothesis is still not a theory, but there is no theory which is not preceded by a hypothesis. If it is found that the A. Yel'kin hypothesis reveals a nonrandom (as the author himself assumes) universality at the times of the catastrophes, a real pattern, this can be not only of 'purely' scientific importance, but also of enormous practical importance. Indeed, almost all the 'triangles' are regions of very enlivened sea and air communications. And it would be important to know when it is possible to enter them without risk and when the risk is great."

"In accordance with this hypothesis, the closest moment of such a 'geometry' of the earth, sun and moon which will cause dangerous situations in the 'triangles' will occur on 20 December of this year and 18 January 1977."

In the opinion of A. Yel'kin, it is not impossible that the nature of formation of force fields in the triangles is also related to the mechanism of prolonged creation of situations leading to earthquakes and seaquakes in definite regions of abyssal depressions. Such a mechanism can lead to destructive underground tremors occurring on approximately 5-8, 20-25 December 1976 and 5-8, 18-22 January 1977 in the following regions: Turkey (in the zone of the Taurus Range), New Zealand and Japan (with the appearance of a tsunami), South America (from 20 to 35°S) and the state of California in the United States.

"It remains to be added that last summer, in a discussion with me, A. Yel'kin postulated the possibility of a strong earthquake in Turkey in late November. As is well known, it occurred. 'Possibly this is a coincidence -- a random event,' stated the scientist."

[160]

#### ACADEMICIAN BREKHOVSKIKH COMMENTS ON BERMUDA TRIANGLE

Moscow PRAVDA in Russian 5 Dec 76 p 6

[Article by L. Brekhovskikh, Chairman Oceanographic Commission USSR Academy of Sciences, "Myths and Facts"]

[Summary] The facts indicate that in the Bermuda triangle there is in actuality an increased number of sea and air catastrophes. Are there any physical processes in the earth's crust, atmosphere or ocean which are responsible for this? At the present time the Soviet research ship "Akademik Vernadskiy" is operating in the Bermuda triangle, carrying out research under the POLIMODE program. The scientists aboard her have noted nothing exceptional. Moreover, in 1969 the bathyscaphe "Ben Franklin," commanded by J. Piccard, crossed the entire triangle and nothing special was observed. What then can account for the great number of accidents and mysterious events in this area? But the best experts agree that there is no need to invoke mysterious forces to explain these events. The fact is that the Bermuda triangle is an area of intensive shipping and air traffic, considerably greater than elsewhere. In addition, this is an area of more complex hydrometeorological conditions for flights and voyages, caused by the influence of the warm waters of the Gulf Stream. Moreover, the relatively strong current rapidly carries away the debris of ships and planes which have experienced misfortune. Hence the illusion that they have disappeared without a trace. Incidentally, the statistics revealed that the accidents in the Bermuda triangle are considerably more numerous during the Christmas holidays, a period of increased traffic on yachts and private aircraft. It should be noted that the insurance company Lloyds of London, which keeps the most detailed statistics and takes into account countless risk factors, does not demand extra premiums for ships sailing in the Bermuda triangle. How do such myths as that of the Bermuda triangle originate? This is attributable to the nature of the capitalistic press, which encourages such stories to maintain circulation.

[159]

## Abstracts of Scientific Articles

### TEMPERATURE FIELD OF SURFACE LAYER IN TROPICS

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 9, 1976  
9V108

[Abstract of article by M. F. Naumenko, B. I. Bikulov and K. I. Chigrakov; Leningrad, TROPEKS-74, Vol 2, Gidrometeoizdat, 1976, pp 25-31, "Large-Scale Spatial Structure of the Temperature Field of the Surface Layer in the Tropical Zone of the Atlantic Ocean"]

[Text] The article describes continuous observations (using a towed electrothermograph) on a number of profiles of latitudinal and meridional directions (their geographic position is given) carried out by the scientific research ship "Mikhail Lomonosov" during the GATE program. The article describes the recording apparatus and the method for processing records. The collected records are regarded as the instantaneous one-dimensional spatial temperature distributions. The authors computed the autocorrelation functions and spectral density functions. The correlation radii were used in computing the horizontal dimensions of the predominant inhomogeneities. The temperature field of the surface layer is characterized by anisotropy caused by the predominant arrangement of the isotherms along the parallels and a temperature increase from the high latitudes to the equator. It is easy to trace the differences in the latitudinal and meridional temperature profiles. There is a specific nature of the temperature inhomogeneities for different regions caused by local peculiarities of the dynamic regime. The values of the dispersions characterizing the amplitude of the temperature inhomogeneities change substantially in dependence on the region and direction of the profiles. The meridional profiles are characterized by inhomogeneities with a dispersion up to  $1 \text{ degree}^2$  and the latitudinal inhomogeneities are  $0.02 \text{ degree}^2$ . A table gives the statistical characteristics of the temperature field and the scale of the inhomogeneities. The spectral density curves for temperature inhomogeneities conform to definite patterns. For latitudinal directions in the range of wave numbers  $10^{-3}$ - $10^{-2} \text{ m}^{-1}$  there is a characteristic decrease in spectral density with an increase in wave

number in conformity to a power law with the exponent -3. For the meridional profiles the dropoff occurs more rapidly and the spectral density itself is an order of magnitude greater than for the latitudinal profiles. Bibliography of five items.

[162]

#### LARGE-SCALE EDDY FORMATIONS IN OCEAN

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 9, 1976 9V78

[Abstract of article by N. I. Tyabin and B. A. Sleptsov-Shevlevich; Leningrad, TROPEKS-74, Vol 2, Gidrometeoizdat, 1976, pp 125-142, "Reality of the Existence of Large-Scale Eddy Formations in the Ocean"]

[Text] During the period of work under the GATE program (July 1974) it was possible to observe the development and destruction of a synoptic cyclonic eddy in the atmosphere and ocean. The "eddy" (vortex) with a diameter of 1,000-1,600 km was formed in the ocean on 1-2 July in the region of discontinuity between the waters of the Northern Trades and Inter-Trades Currents (center --  $9^{\circ}\text{N}$ ,  $23^{\circ}\text{W}$ ); its maximum development was on 5 July and its disintegration was observed on 12 July. Observations from a group of ships situated in the region between the equator and  $15^{\circ}\text{N}$  from  $15^{\circ}$  to  $30^{\circ}\text{W}$  make it possible to establish the peculiarities of all stages in the development of the eddy and make it possible to carry out a comparison with the nature of the course of atmospheric processes. Initially the eddy was noted in the temperature field in the form of a closed region of a positive anomaly in the waters of the Inter-Trades Countercurrent and the accompanying region of a negative anomaly in the waters of the Northern Trades Current to the north. The extent of the anomalies is  $0.5-1.5^{\circ}$  and  $1.5-2.0^{\circ}$  respectively. Later it was possible to establish a correspondence between the anomalies and regions of salinity reduced by  $1^{\circ}/\text{oo}$ , and increased by  $0.6^{\circ}/\text{oo}$  and the direction of the geostrophic and measured currents. Maps of the isoanomalic lines of temperature at the surface and at the horizons 10, 20, 30, 40, 50 and 60 m indicated that the eddy had the form of a highly truncated cone with a vertex at the point  $5^{\circ}\text{N}$ ,  $25^{\circ}\text{W}$  at a depth of 70-75 m; at the horizon 40 m the diameter of the vortex was only half as great as at the surface and at 60 m was 100 km. The eddy developed one to three days after the formation of a cyclone in the atmosphere and its center was only slightly displaced toward the northwest from the center of the atmospheric cyclone and broke down after filling of the cyclone in the atmosphere. According to data from current meters, at the 25-m horizon the current velocity on the southern periphery of the vortex was up to 60 cm/sec and on the north -- 16-18 cm/sec. Bibliography of four items.

[162]

## DISSIPATION OF KINETIC ENERGY IN OCEAN

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 12, No 11, 1976 pp 1227-1230

[Article by M. M. Lyubimtsev, Institute of Oceanology, "Structure of the Field of Dissipation of Kinetic Energy in the Ocean"]

[Abstract] The article discusses the possibility of determining the depth of the thermocline on the basis of a scattered sound signal. The measurements were made in the summer of 1974 in the Caspian Sea from a fixed pile base located 20 km to the northeast of the Apsheron Peninsula, where the sea depth was 40 m (scientific station of the Institute of Physics of the Atmosphere, Institute of Oceanology and Geography Institute Academy of Sciences Azerbaydzhan SSR). The instrumentation is described in detail. The article gives a comparison of the results of measurements of temperature fluctuations and the scattered sound signal. A quantitative comparison of the results of acoustic and temperature soundings within the framework of the resonance theory of volume scattering of sound was made on the assumption of a local isotropy of the thermal structure in the region of scales comparable to the length of the acoustic wave. It is shown that there is a correlation between the intensity of small-scale temperature inhomogeneities and the mean vertical gradient. This makes it possible to hope for a possibility of determining the position of the thermocline by a non-contact acoustic method. However, the small values of the spectral density of temperature fluctuations in the region of large wave numbers and the presence of scatterers of other origin require the application of special selection methods based on a knowledge of the fine dynamic structure of temperature fluctuations; this will be an objective of future research. [134]

## PREDICTION OF ANOMALOUS GRAVITY FIELD IN PACIFIC OCEAN

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, GEOLOGIYA in Russian No 5, 1976 pp 91-98

[Article by A. G. Gaynanov, D. A. Gilod, M. B. Leybov and L. P. Polyakova, Geophysics Department, Moscow University, "Prediction of the Anomalous Gravity Field of the Pacific Ocean and the Pacific Ocean Mobile Zone"]

[Abstract] For the purpose of evaluating the possibility of predicting the anomalous gravity field in the oceans, using the correlations between bottom depths and gravity anomalies, the authors carried out a linear regression analysis of the gravity field and bottom depths of the Pacific Ocean floor. The initial data used were the values of the anomalous gravity field in the Faye and Bouguer reductions and bottom depths averaged using a  $1^\circ \times 1^\circ$  grid. In the analysis the entire investigated area of the Pacific

Ocean and the adjacent continental sectors was broken down into 36 rectangular areas  $35^\circ \times 25^\circ$  and computations were made for each of them separately. The total volume of information prepared and processed on an electronic computer was about 40,000 numbers. For each rectangular area it was possible to obtain a set of fundamental statistical characteristics, that is, the values of the correlation coefficients  $R$ , values of the linear regression coefficients  $A$  and  $B$  for each studied dependence, and also auxiliary characteristics, which include the empirical dispersions  $\sigma_R$ ,  $\sigma_B$ ,  $\sigma_A$  and the values of the confidence intervals, making it possible to evaluate the reliability of the principal characteristics. Histograms of the distribution of the principal statistical characteristics were constructed for each dependence  $\Delta g_F = A \cdot H + B$  and  $\Delta g_B = A \cdot H + B$ . The analysis of the dependence between Bouguer anomalies and bottom depths makes it possible to draw the following conclusions. 1. There is a positive stable correlation between the anomalous gravity field in the Bouguer reduction and bottom depths of the Pacific Ocean, this being attributable to the virtually complete isostatic compensation of large forms of bottom relief. The mean value of the correlation coefficient is 0.78. 2. The nonuniform availability of data for different rectangles exerts no apparent influence on the values of the statistical characteristics. 3. The distribution of the free term  $B$  in the regression equation is characterized by a considerable dispersion of the values and the presence of two modal values.

[117]

#### HAMILTONIAN FORMALISM FOR STRATIFIED MEDIA

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, FIZIKA, ASTRONOMIYA in Russian No 5, 1976 pp 603-607

[Article by V. P. Goncharov, V. A. Krasil'nikov and V. I. Pavlov, Acoustics Department, Moscow State University, "Hamiltonian Formalism for Stratified Media"]

[Abstract] The authors have examined the peculiarities of propagation of waves of a finite amplitude in stratified media. Emphasis is on the possibility of determining the canonical variables for stratified media. The authors have found transforms reducing the Hamiltonian to a diagonal form (see TEZISY DOKLADOV NA VI MEZHDUNARODNOM SIMPOZIUME PO NELINEYNOY AKUSTIKE, Izd-vo MGU, 1975). Dispersion expressions have now been derived for different branches of wave movements admissible in such a medium. As an example of the employed method, the article examines the possibility of radiation of low-frequency (internal) waves in a powerful acoustic packet -- an effect similar to the Cerenkov effect. It is shown that use of the developed method makes it possible to obtain not only quantitative estimates of the effect, but also note the peculiarities of wave interactions in stratified media.

[167]

## REACTION OF STRATIFIED OCEAN TO TYPHOON

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 231, No 3, 1976 pp 567-570

[Article by S. A. Arsen'yev, G. G. Sutyurin and A. I. Fel'zenbaum, Institute of Oceanology, "Reaction of a Stratified Ocean to a Typhoon"]

[Abstract] The article is an examination of the reaction of the upper layer of the ocean, consisting of a quasi-isothermal layer and a thermocline, to an axially symmetric typhoon with a center fixed relative to the ocean surface. A model describing this phenomenon is presented. The proposed model differs from the model of a two-layer ocean (J. J. O'Brien, et al., J. ATMOS. SCI., Vol 24, No 2, 197, 1967) in that it takes into account not only dynamic, but also thermal processes playing an important role in the interaction between a typhoon and the ocean (E. B. Kraus, ATMOSPHERE-OCEAN INTERACTION, Oxford, 1972). The entrainment process is especially important; in this case the thickness of the quasi-isothermal layer can not only be increased, but also decreased. The latter situation is observed under the central part of a typhoon as a result of strong upwelling.  
[131]

## EFFECT OF CURRENTS ON SEA MAGNETOTELLURIC RESEARCH

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 9, 1976 pp 52-57

[Article by V. V. Sochel'nikov, "Effect of Currents on the Results of Sea Magnetotelluric Investigations"]

[Abstract] A solution is obtained for the problem of the variable electromagnetic field of a current in the presence of a conducting bottom. The article gives quantitative estimates of the amplitudes of the electric and magnetic fields in the case of outgoing and incoming tidal currents on the shelf and in the ocean. The data show that the fields of the outgoing and incoming tidal currents are quite strong and this circumstance must be taken into account when carrying out magnetotelluric investigations in zones with incoming and outgoing tidal currents. Variations with a period equal to half a lunar day (about 12 hours 30 minutes) evidently must be excluded from the processing since variations of the magnetic field of external origin having this same period attain a maximum value of only 1-2%.  
[118]

## ANALYSIS OF GRAVIMAGNETIC WAVES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 230, No 2, 1976 pp 315-317

[Article by A. S. Monin, Corresponding Member USSR Academy of Sciences, Institute of Oceanology]

[Abstract] Both gravitational and magnetohydrodynamic waves can be propagated in a heavy electrically conducting fluid in the magnetic field. One of the examples is the ocean. In such waves (which can be called gravimagnetic) the Archimedes and Lorenz forces are comparable so that they must be taken into account simultaneously in the equations of motion. In fluids with a very great magnetic viscosity the electromagnetic effects in gravitational waves are small (nevertheless, their measurement in the ocean can be of interest); on the other hand, in the case of small  $\nu$  they can be extremely important (for example, in the fluid outer layer of the earth's core with  $\nu \sim 10^4 \text{ cm}^2/\text{sec}$ , if it is stratified subadiabatically; in the corona, chromosphere and stably stratified solar core, etc.).

[35]

## REVIEW OF OCEAN ACOUSTICS

Moscow PRIRODA in Russian No 11, 1976 pp 34-43

[Article by I. B. Andreyeva and L. M. Brekhovskikh, "Ocean Acoustics"]

[Abstract] Some of the major aspects of oceanic acoustics are considered. These include: sound scattering layers, wave covered surface and the acoustics of the ocean floor. The senior author is the author of the book FIZICHESKIYE OSNOVY RASPROSTRANENIYA ZVUKA V OKEANE (Physical Principles of Sound Propagation in the Ocean), Leningrad, 1975. Necessarily, the three subjects are covered sketchily, yet the article is tightly written. For example, it is noted, sound scattering layers in the ocean can serve as indicators of internal waves. The propagation of internal waves is accompanied by vertical oscillatory movements of water masses in the depths of the ocean. The greater part of the organisms in the sound scattering layers is passively transported together with the water like floats having a neutral buoyancy. On the echograms showing sound scattering layers it is common to see that the depth of the layer varies. Experiments have shown that these variations occur synchronously with internal waves. On the records of sound scattering layers the internal wave is clearly discriminated; its length in this case is about 4.5 km. The mean depth of the sound scattering layer was approximately 100 m.

[162]

#### IV. TERRESTRIAL GEOPHYSICS

##### Abstracts of Scientific Articles

###### SEISMIC WAVES IN INHOMOGENEOUS MEDIA

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 9, 1976  
9G154

[Abstract of article by Vlastislav Cervený and Karel Pec; Bucharest, STUD. TECHN. SI ECON. INST. GEOL. SI GEOFIZ., No 10, Part A3-a, 1975, pp 71-95, "Seismic Waves in Inhomogeneous Media -- A Review"]

[Text] This is a review of the theoretical methods used in study of the propagation of seismic body and surface waves in inhomogeneous media. Attention is given to the propagation of waves in the crust and in the upper mantle. Elastic waves in completely elastic media are also considered. The following four theoretical approximations are used in the study of seismic wave propagation: a) the method of ray series and its modifications; b) precise ray theory; c) wave method; d) direct numerical methods (finite differences and finite elements method). The first method is used successfully in an investigation of wave propagation in horizontally inhomogeneous media with curvilinear boundaries. The next two methods (b,c) can be used only for relatively simple models of the medium (homogeneous parallel layers). The wave method plays the principal role in a study of surface waves. This same method is convenient in studying body waves, that is, gives a precise solution in a number of problems, such as reflection from a rigorously horizontal transition layer. The finite differences method can be applied to rather complex media. There is a discussion of the possibilities and limitations of these methods in solving different seismological problems. Bibliography of 120 items.

[162]

###### ACOUSTIC MODELING IN DEEP SEISMIC SOUNDING

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 9, 1976  
9G39

[Abstract of article by V. I. Naydich and G. N. Glevskiy; Irkutsk, SOVREM. ISSLED. ZEMN. KORY, 1975, pp 96-98, "Acoustic Modeling of Some Situations Arising in Deep Seismic Investigations of the Baykal Rift"]

[Text] A study was made of the possibility of using seismic methods for detecting regions of reduced velocity (or antiroots) assumed to exist in the mantle beneath rift zones. The authors modeled a lens of the anomalous mantle with an area of 200 x 200 km and with a thickness of 20 km. The height of the asymmetric antiroot is 10 km, the width is 60 km. Crustal thickness is 40 km. The experiment was carried out using a solid model fabricated from plastic, polyethylene and epoxy resin (440 x 200 x 150 mm<sup>3</sup>). The model of the anomalous zone was a horizontal cylindrical body with a lenticular section. The model parameters were computed using similarity theory. The observations were made on bases corresponding to bases of 200 and 230 km in the field. The boundary velocities were determined most precisely by using the method of point soundings. The greatest deviations between computed  $V_{\text{bound}}$  and the true boundaries (-2.8%) were determined under the "antiroot." The accuracy in determining the position of the discontinuities is dependent on the "shot-reception" distance and increases with the joint use of the refracted and reflected waves. The influence of "lateral" reflections is analyzed.

[162]

#### FORMATION OF CRUST IN NORTHWESTERN PACIFIC OCEAN

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 9, 1976 9G48

[Abstract of article by P. M. Sychev; --, TRUDY SAKHALIN. KOMPLEKS. NII DAL'NEVOST. NAUCH. TSENTRA AN SSSR, No 37, pp 29-48, "Deep Faults and Formation of the Earth's Crust in the Northwestern Sector of the Pacific Ocean"]

[Text] In the northwestern sector of the Pacific Ocean the surface manifestations of faults include chains of volcanoes, island arcs, archipelagoes of islands, rises, underwater ridges and mountains. According to seismic data, the upper mantle beneath tectonically active zones has anomalous properties: reduced velocities and increased absorption of elastic waves. At the same time, in the earth's crust there is an increase in thickness of the granite layer, formation of uplifts and anticlinoria as a result of magmatic activity. On the boundaries of the zones of uplifting and subsidence one can observe the presence of dislocations. The reason for all the phenomena is processes transpiring in the upper mantle. The heat source for them may be the gravitational differentiation of matter in the deep layers of the earth, particularly intensive on the boundary between the liquid core and the lower mantle. The transformation of gravitational energy into thermal energy is accompanied by the release of a great quantity of heat. The carriers of thermal energy may be high-temperature melts forming during the rising of centers of melts to different levels in the lower and upper mantle. Faults arise under the influence of high pressure and along these magma rises upward, forming intrusions, uplifts and folded systems. In this way the earth's shells, different crustal structures and the surface relief are formed. Bibliography of 79 items.

[162]

## GRAVITY ANOMALIES AND THEIR GEOLOGICAL NATURE

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 9, 1976  
9G49

[Abstract of article by Yu. A. Pavlov and A. V. Zhuravlev; --, TRUDY SAKHALIN. KOMPLEKS. NII DAL'NEVOST. NAUCH. TSENTRA AN SSSR, No 37, 1975, pp 144-154, "Gravity Anomalies and Their Geological Nature in the Zone of Juncture Between Sakhalin and Hokkaido"]

[Text] The gravity field in the waters of the Sea of Okhotsk in the region of juncture between Sakhalin and Hokkaido is characterized by reduced gravity levels in comparison with extensive maxima of the abyssal depressions of the Sea of Japan and the Sea of Okhotsk. Against the background of this regional decrease one can clearly discriminate a number of large alternating linear zones of maxima and minima with meridional strikes. The reduced regional background is determined by the change in the total thickness of the earth's crust in this region. The presence of major elongated zones characterized by increased and decreased field anomalies is caused by a basic factor -- the relief of the top of Pre-Upper Cretaceous formations characteristic for the region. Anomalous zones of gravity maxima coincide with uplifting or with surface outcroppings of arched formations of Pre-Upper Cretaceous rocks. The zones of minima are associated with major depressions filled with strata of sediments of Paleogene age. On the boundaries between linear zones and also in the region of major dislocations, on the slope of the Kurile depression, there are gravitational steps with a gradient of 5-6 mgal/km. An intensive gravity minimum in the western part of LaPerouse Strait and the presence of anticlinal structures there make it possible to postulate here Paleogene and Upper Cretaceous deposits of considerable thickness, which are highly promising with respect to the possibilities of finding petroleum and gas. Bibliography of 10 items.  
[162]

## ANOMALOUS MAGNETIC FIELD IN PACIFIC OCEAN MOBILE ZONE

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 9, 1976  
9G51

[Abstract of article by Ye. V. Kochergin and M. L. Krasnyy; --, TRUDY SAKHALIN. KOMPLEKS. NII DAL'NEVOST. NAUCH. TSENTRA AN SSSR, No 37, 1975, pp 163-176, "General Patterns of the Anomalous Magnetic Field of the Northwestern Part of the Pacific Ocean Mobile Zone"]

[Text] The most characteristic feature of the anomalous magnetic field of the northwestern part of the Pacific Ocean is intensive, extended, linear anomalies of a northeasterly strike. The constancy of the direction of the axes is also manifested in the marginal seas and on the continent. The deviations of the axes of the anomalies are associated with fault zones. In the northeastern part of the Pacific Ocean linear magnetic anomalies cut the Aleutian abyssal trench; within the limits of Hokkaido and Honshu Islands linear anomalies cut across the Japanese Trench, which indicates a nondependence of development of these structures on one another. A peculiarity of the anomalous magnetic field in the region is a regional, positive magnetic anomaly situated between the crests of the Kurile-Kamchatkan and Aleutian Island arcs and the abyssal trenches. The magnetic anomalies of underwater rises (Bauers, Shirshov, and others) are caused by volcanic and intrusive activity. A decrease in the anomalies along the shores of Kamchatka is observed in connection with thick sedimentary deposits. The local anomalies of the Greater Kurile Ridge coincide with dislocations of the volcanic-sedimentary complex. The marginal seas (Sea of Okhotsk and Sea of Japan) are characterized by edge anomalies in the zone of transition of the suboceanic crust into a subcontinental crust, with sharp gradients of crustal thickness. The magnetic field of the continent has a nature which is attributable to intrusive and extrusive rocks in the sedimentary layer. Bibliography of 26 items.

[162]

#### METHOD FOR SOLVING INVERSE PROBLEMS IN GRAVIMETRIC PROSPECTING

Kiev GEOFIZICHESKIY SBORNIK in Russian No 70, 1976 pp 64-70

[Article by Ye. G. Bulakh and M. N. Markova, Geophysical Institute Ukrainian Academy of Sciences, "Solution of Inverse Problems in Gravimetric Prospecting for Sloping Structures by the Minimization Method"]

[Abstract] A solution of inverse problems in gravimetric prospecting is proposed. If the investigated region has rather complex physical geology and the interpreter has some definite information on the structure of geological objects, in many cases the only effective interpretation method is the best fit method. The article cited above gives an algorithm for such a stage in an automated system for the interpretation of gravity anomalies. It is applicable in the case of sloping contact surfaces. The use of this stage is illustrated by an example from practical geological interpretation.

[110]

#### LAYERS WITH REDUCED VELOCITY IN CRUST OF SOUTHERN TURKMENISTAN

Ashkhabad IZVESTIYA AKADEMII NAUK TURKMENSKOY SSR, SERIYA FIZIKO-TEKHNIЧЕСКИХ, ХИМИЧЕСКИХ И ГЕОЛОГИЧЕСКИХ НАУК in Russian No 5, 1976 pp 93-98

[Article by V. A. Bezgodkov and V. S. Orlov, Institute of Physics of the Earth and Atmosphere Academy of Sciences Turkmen SSR, "Presence of Layers with Reduced Velocity in the Earth's Crust in Southern Turkmenistan According to Data on Exchange Waves (Type PS) of Earthquakes"]

[Abstract] The authors have studied in detail the relationship of the arrival signs for P and PS waves for cases when the exchange boundary is "anomalous" and above it in an n-layered medium there is an arbitrary number of "normal" or "anomalous" boundaries, and also a case when the exchange boundary is "normal" and above it there is some number of "normal" or "anomalous" boundaries. It was found that if the relationships of the signs of the exchange waves and the longitudinal waves are "normal," these exchange waves correspond to "normal" boundaries, that is, boundaries above which the velocities of the transverse waves are less than in the lower medium bounding on it. If the relationship of the arrival signs of the exchange and longitudinal waves is opposite the "normal," such exchange waves correspond to "anomalous" exchange boundaries, that is, boundaries above which the velocity of propagation of the transverse wave is greater than in the underlying medium. Thus, by knowing the relationships of arrival signs of a series of waves of the P and PS types it is possible to discriminate layers with reduced velocities. Exchange waves with "anomalous" relationships of signs with the longitudinal wave generating them will correspond to the tops of such layers. The method makes it possible to study terrigenous deposits of the sedimentary cover covered with layers of dense calcareous deposits, frequently being a "screen" in investigations using other seismic methods. Using the method it was possible to discriminate layers with reduced velocities in the crust of southern Turkmenistan.

[169]

#### METHOD FOR COMPUTING GRAVITATIONAL FIELD OF THREE-DIMENSIONAL MASSES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 11, 1976 pp 61-67

[Article by G. Ya. Golizdra, Dnepropetrovsk Mining Institute, "Rapid Method for Computing the Gravitational Field of Three-Dimensional Masses on an Electronic Computer"]

[Abstract] The author describes a rapid method (using an electronic computer) for solving the direct problem of determining the gravitational field of three-dimensional masses. The computation algorithm is based on the

idea of analytical continuation into the upper half-space. The merit of this scheme is that it makes use of available numerical methods for the transformation of potential fields. In particular, there is a considerable broadening of the possibilities of existing automated systems for the processing and interpretation of the results of gravimeter surveys. The algorithm makes no use of standard programs for computing irrational and transcendental functions, on which much time is usually expended. The key formula (22) and the algorithm for transformation of the initial matrix are very simple and require a minimum number of arithmetical operations. Having a carefully prepared program, the analytical continuation program gives one of the most rapid methods for computing the gravitational field of three-dimensional masses of variable density.  
[133]

#### EFFECT OF SEA TIDES ON EARTH TIDES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 11, 1976 pp 3-6

[Article by B. P. Pertsev and M. V. Ivanova, Institute of Physics of the Earth, "Allowance for the Influence of Sea Tides on Gravimetric Earth Tide Observations in the Eastern Part of the United States"]

[Abstract] Tidal variations of gravity were registered by Robinson (JGR, 79, No 29, 1974) at ten stations in the southeastern United States. Using this as a point of departure, the authors show that in this region the variations in the spatial distribution of gravimetric factors  $\delta(M_2)$  and  $\delta(O_1)$  are determined for the most part by the influence of sea tides. The values of these parameters, corrected for the indirect effect, agree well with the similar values obtained for Western and Central Europe. However, for the western states the picture is completely different. The  $\delta(M_2)$  and  $\delta(O_1)$  values, corrected for the indirect effect, increase with approach to the shores of the Pacific Ocean. A possible reason for this phenomenon may be the influence of the San Andreas fault or other inhomogeneities in structure of the earth's upper layers.  
[133]

#### THEORY OF THERMOGRAVITATIONAL CHANGES IN EARTH'S VOLUME

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR, NAUKI O ZEMLE in Russian Vol 29, No 3, 1976 pp 3-9

[Article by A. T. Aslanyan, Institute of Geological Sciences Armenian Academy of Sciences, "Thermogravitational Criterion of Changes in the Earth's Volume"]

[Abstract] A thorough examination is made of the criterion of global homological change in the volume of a solid planet. All available statistical data on the earth's contraction and expansion are examined. Computations show that an initially cold earth will homologically expand when the mean temperature is greater than  $6,350^{\circ}\text{K}$  and is compressed when the temperature is less than  $6,350^{\circ}\text{K}$ . Since the earth's mean temperature according to the most different estimates is not greater than  $4,000^{\circ}\text{K}$ , the earth's compression during the period of its geological evolution is unquestionable. Some estimates show that during the last 2,000 years the earth's radius has decreased by approximately one meter per thousand years. However, it is clear that there can be no constant homological compression of the planet as a whole and there must be density fluctuations in different regions of the deep layers of the planet. Thus, superposed on the general directed process of gravitational compression of the planet there is a fluctuating rhythm or at any rate, gaps in the compression process complicated by thermogravitational convection. A quantitative estimate of the scales of these dynamic effects can shed light on a number of timely problems in geotectonics. [76]

#### MAGNETOTELLURIC-MAGNETOVARIAION STUDIES IN CISCAUCASIA

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 9, 1976  
pp 106-110

[Article by N. P. Vladimirov and N. A. Deniskin, Institute of Physics of the Earth, "Results of Deep Magnetotelluric and Magnetovariation Investigations in Ciscaucasia"]

[Abstract] During 1973 specialists of the Institute of Physics of the Earth carried out work for studying the relationship between magnetotelluric and geothermal investigations in Ciscaucasia. This work included a critical analysis of the geophysical work done earlier in this area. In this region different organizations over a period of years have carried out several hundred magnetotelluric soundings in the range of periods 20-3,600 sec. The data show that in western Ciscaucasia the magnetotelluric method gives information which usually agrees with data obtained by drilling and seismic prospecting methods. It is clear that magnetotelluric sounding in regions with quiet tectonics reliably determines the relief of the reference horizon of different ages, since this has high resistivity. Combined study of the area by magnetotelluric and magnetovariation soundings and also the distribution of Vize vectors gives no basis for speaking of a different deep structure of eastern and western Ciscaucasia. The results of the investigations are influenced to a considerable degree by a thick stratum of low-resistivity sedimentary rocks which occur widely in the region. Due to the influence of the sedimentary cover, the crust and upper mantle cannot be broken down into different layers on the basis of resistivities. [118]

## V. UPPER ATMOSPHERE AND SPACE RESEARCH

### News

#### INTERVIEW WITH COSMONAUT SEVAST'YANOV

Moscow ZHURNALIST in Russian No 12, 1976, pp 20-22

[Interview conducted by G. Kuznetsov: "The Signal System of Society"]

[Excerpts] Corr: Recently I read that all space experiments of mankind, including trips to the moon, have already paid for themselves simply by the use of artificial satellites for communication, meteorology and geology.

Sevast'yanov: Geology has received information such as it has never had. Many discoveries of petroleum and gas provinces have already been made on the basis of space information, in particular on the basis of photographs which I took together with Andriyan Nikolayev in the "Soyuz-9."

Corr: Cosmonauts are receiving definite assignments from geologists?

Sevast'yanov. Yes. For example, we photographed Kara-Bogaz-Gol and helped to determine more precisely the reserves of minerals, whereas in Kazakhstan we discovered fresh water at a depth of several tens of meters. We received assignments not only from geologists; the amount of information received from space is enormous. Condition of the forest; views of crops; movement of ice and even schools of fish. In the second flight, on the "Salyut-4," we photographed the Kerch Strait. A dam will be built there in order to raise the level of the Sea of Azov, to prevent its salinization and restore fishing. We photographed the gulf at different times over a period of two months on a special photographic film. The mobility of sand, bottom relief, peculiarities of currents -- all these can be seen on the photographs. And now "Gidroproyekt" will use these photographs in order to "tie in" the dam to the most convenient place, not where it was planned earlier. We photographed the Pamirs in order to compile a geological map of this area. On the basis of these photographs specialists have already made discoveries of deposits of rare metals and this alone will evidently pay for our entire flight. Along the course of the Vaksh River, where seven electric power stations will be constructed, we discovered three geological

faults about which no one has known. It was necessary to refine the site of the future construction. The designers of future mountain dams also assisted our work; they are being constructed by means of explosions for protecting the Fergana valley against mudflows on the principle of the dam at Medeo which protects Alma-Ata.

The problem of the limitedness of our natural resources and the problem of protecting the environment -- this alone assures us of work for long years. How will mankind solve this problem? I do not know, but it is clear that without space flights -- manned and unmanned -- they cannot be solved. Power plants will evidently be created in space; these will be both solar and nuclear. Technological problems will be solved in space which cannot be solved on earth: these include obtaining superpure metals, obtaining crystals for electronic instruments. Two years ago Neil Armstrong, in the name of NASA, handed to then-President Ford a crystal of niobium measuring 25 mm which had been grown aboard the "Skylab" orbital station. On earth the maximum size of a niobium crystal is 2 1/2 mm. They say that the future of electronics is dependent on such crystals, cultivated under weightlessness conditions. It is very promising to obtain in space superpure medicines, which are also of more than a little importance for the future of mankind...

Even now we are expending in flight 65-70% of our time in the solution of purely applied problems and only 30-35% on fundamental scientific investigations, where it is too early to speak about profitability, but... But even now hundreds of astronomers in the world are citing P. Klimuk and me, since we were the first in the world to register the notorious "black hole." It was predicted theoretically long ago that zones of superdense matter can exist in places where gravitational forces are so great that even light cannot erupt from there. And the instruments aboard the "Salyut-4" actually discovered such a "hole" in space. In addition, the spectrograms of noctilucent clouds became a scientific sensation.

Corr: All these arguments in favor of the profitability of space in a direct sense and in a figurative sense, indeed, can probably be indicative of a scientific profitability, although even the sensational discovery of a "black hole" can scarcely give an economic effect in the foreseeable future.

Sevast'yanov: On the other hand, this realization is a constant requirement of man in learning about the universe.

Corr: Recently journalists, in speaking about knowledge in space flights, in particular the comprehension of the "man and weightlessness" problem, have begun to turn more attention to unforeseen flight factors. For example, Yaroslav Golovanov wrote that despite the comforts of the "Salyut" station, this is far from being a sanatorium. How does one relate to the appearance of unforeseen flight factors? After all, any flight is a testing of something new and the work of a test pilot even on earth can be quite dramatic. "The flight is going normally, the program is being implemented, but this

does not at all mean that there are no difficulties..."

Sevast'yanov. This means that the difficulties have been normally overcome. Petr Klimuk and I aboard the "Salyut-4" had a program for different kinds of repair work. The fact is that on the first expedition, that of Gubarev and Grechko, there were some system failures. For the most part these were scientific systems and the failures were unrelated to the danger of man's presence aboard. We made repairs under all points of the program and in the spectrograph we fixed three channels, but were unable to repair the fourth. So we stated in the report. But then we had other unforeseen repair work.

We had an excellent system for regenerating a water condensate. We carried out tests. First for a week I drank water from this system and then joined Petya and for 1 1/2 months we drank this water. Ordinary water was added, to be sure, since we had a supply of that, but tests are tests. The system gave excellent results. And suddenly a defect was discovered: there was an increase in humidity within the station. We could not understand why, but it increased. We examined everything which was related to water. It was found that a distributing hose which runs from the container (during weightlessness it is impossible to pour water into a cup, it spills out) had broken. We eliminated the defect and told about this in a television report.

There was also the experimental "Kaskad" system -- the system for orienting the station. We had to test it. We used this system for two months; this makes it possible to reduce the amount of fuel expended on orientation by many times. It would seem that solution of purely technical problems is involved. It is also possible to tell about this. But indeed there are actually moments full of drama. One can imagine a conversation between the earth and physicians and the physicians say to us: both of you twice had cardiac irregularities, and both of you simultaneously. Precisely at the moment when the panel gave an emergency signal. An emergency in the orientation system! This means that the station can now spin up to great velocities. This occurred outside the zone of radiovisibility, over the ocean. We undertook everything which had been proposed and then reported to earth. They strictly ordered that nothing be touched, that no system be switched on, but we proposed, on the contrary, that the test be carried out and systems be switched on again; we got the idea that the alarm was spurious. The "earth" thought, computed, we covered a revolution, then another revolution, and finally agreed with our idea. We carried out a test under observation from the earth, in the zone of radiovisibility, and our idea was confirmed: the automated protection system had been incorrectly triggered. There was no emergency. The automatic system fed false information about an emergency. We began to work with visual control and flew on normally.

Corr. Space flights are becoming more prolonged and stories about them are becoming increasingly detailed. And penetration into the psychology, into the personal experiences of cosmonauts seems to me inevitable for journalists. I recalled your story about how you, awakening during weightlessness,

were startled: two arms hovered above you. You discovered that these were your own arms.

Sevast'yanov: During weightlessness man occupies a position similar to the position of a baby in its mother's womb. In this position no signals arrive from the extremities; as long as you do not move your arms you do not feel them and your arms hover over your face. And you are naturally frightened.

Corr: In one western book on journalism it states: journalists commune with the famous but do not enjoy their friendship.

Sevast'yanov: For the West this is true. But in our country the cosmonauts are friends with journalists. I have good friends among reporters. Probably this can also be attributed to my wife, who works for a news agency. Cosmonauts also relate to our newsmen with respect because in our publications, in contrast to western publications, there is no false information concerning space matters.

P. Klimuk and I had a press conference at Philadelphia on 12 June 1976. I told about future orbital scientific stations. I told how they will have several docking modules to which both manned and unmanned ships will approach. These ships will refuel stations, deliver equipment, in order to change the program for scientific investigations. After all, such stations exist for years. It is not necessary that people fly for this purpose; unmanned transport systems will be created.

And now ten days elapse from the press conference and we launch the "Salyut-5" station, and the WASHINGTON POST contains a small note: "If one interprets the words of cosmonauts Klimuk and Sevast'yanov, it can be assumed that the 'Salyut-5' has two docking units."

At the press conference I stated that our "Salyut" station was highly promising, had a volume of 100 cubic meters, that if it carried a crew of six, let's say, rather than two, they would live there beautifully and make observations, that they would have a full work load, that there was so much instrumentation there. But the WASHINGTON POST "interpreted" these words in such a way that the "Salyut-5" would presumably carry six men. Two days later, on 24 June, the Voice of America, citing the WASHINGTON POST, and without including the words "it can be assumed," asserted very directly that according to the statements of the Soviet cosmonauts Klimuk and Sevast'yanov, the "Salyut-5" would have two docking modules and a six-man crew. You yourself understand that this kind of cooperation with the press brings no joy.

Corr: After the first flight your meeting with terrestrial gravity, to say the least, was not very pleasant. After the second flight you wrote that the first days on earth were like a great burden, but in general as a result of daily training the meeting with terrestrial loads passed normally. Do you feel that the problem of whether earthlings can live and work in a state of weightlessness no longer exists?

Sevast'yanov: Yes, it is possible to live and work there, but only a specially prepared, trained person. And an indispensable condition is physical culture in space. Earlier we did not know this. When I returned from the first flight, which lasted 18 days, my heart was reduced in size (according to the area on the roentgenogram). And only after three months everything returned to normal. But on the second flight we were engaged in physical exercises for two hours a day, special equipment was provided and the heart in the course of two months changed considerably less and recovered in 18 days.

[194]

#### "MORSVYAZ'SPUTNIK" ASSOCIATION FORMED FOR MARINE SATELLITE COMMUNICATIONS

Moscow PRAVDA in Russian 17 Dec 76 p 6

[Article by Yu. Andreotti: "From Any Point in the World Ocean"]

[Text] The All-Union Association "Morsvyaz'sputnik" has been formed in the USSR Merchant Marine Ministry. It supports the technical operation of Soviet and international artificial earth satellites for communication and navigation in the sea expanses to the north and south of the equator.

"So the Soviet Union is among the countries participating in the newly created satellite communication international organization INMARSAT," states the association chairman Yu. S. Atserov. "The created international satellite system eliminates the frequent interruptions in radio communication between ships and ports. These six- and eight-hour pauses arise due to a deterioration of the propagation of short waves after disturbances in the ionospheric layer over the earth, magnetic storms. But the radio bridge ship - satellite - ground station faultlessly and rapidly connects subscribers."

"Even now provision is being made for installing satellite communication equipment on major Soviet ships now under construction. Due to this the control of movement of the ships will become more routine."

"The most diversified information will be transmitted via the radio bridge, including personal communications. After a few years there will be few who would be surprised by telephonic conversations from any point of the world ocean between crew members and their families. The radiotelephonic

connection is made virtually instantaneously. Using ordinary telephonic equipment a subscriber on a ship dials the necessary number. The parabolic dish of the antenna-transmitter sends signals to the satellite, its apparatus transmits these to the ground station having an output to the automatic telephonic communication system. The quality of the conversation will be no worse than between two subscribers in the same city, although the signal has to cover a distance equal to the length of two terrestrial equators."

"We selected a frequency in the decimeter range for satellite communication. It has great immunity to interference."

"Satellites of the INMARSAT system will be put into a synchronous, geostationary orbit at an altitude of about 36,000 km. The velocity of their revolution is identical with the velocity of the earth's rotation and therefore they can appear to be hovering fixed above the observer's head. For ensuring stable communication between all regions of the world ocean from 70°N to 70°S it is necessary to have only three satellites -- one each over the Indian, Pacific and Atlantic Oceans."

"A convention on international satellite communication has already been signed by 12 countries and operational agreements have been signed by five. In writing the convention and creating the INMARSAT organization, the socialist countries -- Poland, GDR, Bulgaria and Cuba have actively participated."

"Preliminary economic computations show that the cost of shipboard equipment for space communication will pay for itself for each ship in the course of a year. Later the INMARSAT communication system will be used in navigation as well. Satellites can become space radio beacons."

[177]

#### CENTRAL TELEVISION INTRODUCES NEW SYSTEM FOR REMOTE AREAS

Moscow PRAVDA in Russian 1 Jan 77 p 2

[TASS Report: "The Horizons of the 'Orbita' Expand"]

[Text] On the eve of the new, 1977 year Central Television began broadcasting on a new system for regions receiving the "Orbita" program schedule. Three program schedules have been introduced instead of one. Each of them embraces a region located in three time zones.

The program schedules are structured according to the first program schedule of Central Television. Broadcasting begins at 0900 hours and concludes at 2300 hours local time, calculated for the middle time zone of each region.

This new system of television broadcasting with three "Orbita" channels makes it possible for people to live in different and remote regions of the country to watch broadcasts of the first program schedule of Central Television in their entirety and at a convenient time. [5]

#### BEREGOVY COMMENTS ON PREPARATIONS FOR JOINT EXPERIMENTS IN SPACE

Moscow IZVESTIYA in Russian 31 Dec 76 p 5

[TASS Report: "Preparation for Joint Flights"]

[Text] Preparations have been started for Soviet cosmonauts' joint flights with representatives of socialist countries. The first group of the participants in future flights from Czechoslovakia, Poland and the GDR were warmly received by their Soviet colleagues. The director of the Center for the Training of Cosmonauts imeni Yu. A. Gagarin, Air Major General G. T. Beregovoy, told a TASS correspondent that the guests have familiarized themselves with the laboratory, technical plant and training facilities of the Center. Representatives of Bulgaria, Hungary, the GDR, Cuba, Mongolia, Poland, Rumania and Czechoslovakia will take part together with Soviet cosmonauts in joint space flights.

As G. T. Beregovoy pointed out, there has been a recent tendency toward large-scale international cooperation in space research. The joint Soviet-American flight on board the Soyuz and Apollo ships was a success. For more than ten years socialist countries have been cooperating within the framework of the Interkosmos program which is based on full equality, mutual assistance and comradely support. Besides artificial satellites, tens of meteorological rockets were launched and more than 20 experiments in various branches of science were carried out through the efforts of the fraternal countries. The launching of the "Interkosmos-15" satellite marked the emergence of a new generation of satellites -- automatic, general purpose orbital stations. [5]

## Abstracts of Scientific Articles

### TWO-FREQUENCY RADIO PROBING OF VENUSIAN IONOSPHERE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 14, No 6, 1976 pp 819-823

[Article by Yu. N. Aleksandrov, M. B. Vasil'yev, A. S. Vyshlov, V. M. Dubrovin, A. L. Zaytsev, M. A. Kolosov, A. L. Krymov, G. I. Makovoz, G. M. Petrov, N. A. Savich, V. A. Samovol, L. N. Samoznayev, A. I. Sidorenko, A. F. Khasyanov and D. Ya. Shtern, "Preliminary Results of Two-Frequency Radio Probing of the Daytime Ionosphere of Venus Using the Satellites 'Venera-9' and 'Venera-10'"]

[Abstract] Radio probing of the daytime ionosphere of Venus was carried out when the stations emerged from behind the planetary disk. During measurements the station transmitters emitted two coherent signals in the decimeter (32 cm) and centimeter (8 cm) wavelength ranges with the frequency ratio  $p = 4$ . Signal reception was with a two-channel dispersion interferometer. The decimeter and centimeter signals were registered in analog form on a magnetic tape in the bands 8 and 32 KHz respectively. The method for processing the records is described. Three profiles are shown and analyzed. Figure 1 is a profile obtained when the "Venera-10" emerged from behind the planet on 2 November 1975; Fig. 2 is a profile based on "Venera-9" observations for 28 October 1975, corresponding to a solar zenith angle of  $46^\circ$ . Profile 3 was obtained from measurements on 23 November 1975 when the "Venera-9" emerged from behind the planet; it relates to the case of probing of the evening ionosphere. Thus, as a result of this experiment for the first time it was possible to determine the vertical profiles of electron concentrations in the Venusian ionosphere under different illumination conditions and there was found to be a lower maximum of ionization at an altitude of about 125 km.

[168]

## THEORETICAL MODEL OF IONOSPHERIC BALANCE EQUATION

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 16, No 6, 1976, pp 986-992

[Article by R. Dettmann and D. Felske, Electronics Institute German Democratic Republic, "Theoretical Model of Ionospheric Balance Equation"]

[Abstract] Proceeding on the basis of the balance equation for charge carriers in a unit volume of the high ionosphere, the authors have developed a model of formation, recombination and transport of carriers which is correct under definite conditions. Using this model it was possible to write a differential equation in partial derivatives for the density and motion of charge carriers. The article discusses the numerical solution of the equation and the results in dependence on the initial parameters. The results are compared with data from measurements of the total electron content and other parameters dependent on the total electron content. It is noted that the determined dependence of the total number of electrons on season of the year does not completely correspond to reality, but quite correctly reflects the difference between diurnal variations during summer and winter. It also almost correctly reflects the ratio of the maximum to the minimum of the diurnal variations during summer. The model would correspond far better to reality if the initial data relied on the real parameters of the neutral gas.

[144]

## FORMATION OF HIGH-LATITUDE IONOSPHERE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 16, No 6, 1976, pp 993-1001

[Article by M. G. Deminov and V. P. Kim, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, "Role of Electric Fields in Formation of the High-Latitude Ionosphere"]

[Abstract] On the basis of an analytical solution of a system of continuity equations for the charged components of the medium an attempt is made to discuss the influence of electric fields on the formation of the high-altitude distribution of concentrations of the ions  $O_2^+$ ,  $NO^+$ ,  $O^+$ ,  $N^+$ ,  $He^+$  and  $H^+$  at the levels of the F region and the outer ionosphere. Emphasis is on the ions  $O^+$  and  $XY^+$ ,  $N(XY^+) = N(O_2^+) + N(NO^+)$ , which are fundamental for the altitudes of the F2 and F1 regions respectively. The paper gives a full discussion of the influence of electric fields on formation of the high-latitude ionosphere and it is shown that when  $E \geq 100$  mV/m molecular ions can predominate to altitudes of 600-800 km and at altitudes of 800-1,000 km their concentration is of the order of  $10^3$  cm $^{-3}$ .

[144]

## REGISTRY OF GEOMAGNETIC PULSATIONS IN SOVIET-GERMAN EXPERIMENT

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 16, No 6, 1976 pp 1090-1096

[Article by V. A. Troitskaya, L. N. Baranskiy, M. B. Gokhberg, I. V. Sterlikova, B. N. Belen'kaya, J. Munch, K. Wilhelm, K. Faulkner, M. Siebert, O. Hillebrandt, I. P. Kharchenko, N. A. Ivanov and Yu. A. Kopytenko, Institute of Physics of the Earth, Aeronomy Institute, West Germany, Geophysical Institute Gottingen University, West Germany, Siberian Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Geophysics Institute USSR Academy of Sciences and Leningrad Division Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, "Preliminary Results of a Soviet-German Experiment with Synchronous Registry of Geomagnetic Pulsations on Meridional and Latitudinal Profiles of Stations"]

[Abstract] On the basis of materials on synchronous observations of geomagnetic pulsations carried out in October 1974 at stations along the geomagnetic meridian and along the geomagnetic parallel  $51^\circ$  it was possible to investigate the meridional and latitudinal distribution of the intensity of Pc3-4 and Pi2 pulsations. There were 31 stations in the observation network (listed in a table). The range of recorded frequencies occupied the band from 0.01 to 0.3 Hz, and at some stations up to 2 Hz. Among the findings were the following. The position of the subauroral minimum of Pc3 virtually does not change with a change in the  $A_p$  index. In the case of high values of the  $A_p$  index the projection of the plasmopause onto the earth's surface was situated to the south of the subauroral minimum of Pc3 intensity. Both these facts contradict the results reported by L. A. Dmitriyeva, et al. (AN. GEOPHYS., 31, 1975, p 93), in which it is stated that the projection of the plasmopause, being regularly situated to the north of the subauroral minimum of Pc3 intensity, moves together with it during a change in geomagnetic activity. These and other findings reported in the paper indicate a necessity for further investigations of geomagnetic pulsations in the range of geomagnetic latitudes  $50-65^\circ$ , correlated with satellite observations of cold plasma.

[144]

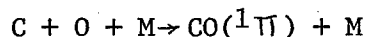
## FINDINGS ON NIGHT AIRGLOW OF VENUS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 14, No 5, 1976 pp 796-798

[Article by V. I. Slysh, "Identification of the CO Molecule in the Night Airglow Spectrum of Venus"]

[Abstract] Using the spectrometer carried aboard the "Venera-9" and "Venera-10" it was possible to detect a nightglow of Venus whose spectrum consists of eight bright bands in the wavelength range from 3900 to 6500 Å. These

bands are not identified with emission spectra of the most probable gases known from laboratory experiments but it is postulated that a new electron transition of carbon dioxide is involved. The analysis presented here shows that for the excitation of glow in the visible region of the spectrum the required energy is greater than 10 eV. On the nighttime side of Venus the source of excitation energy can be fast electrons or chemical reactions. Fast electrons can enter the atmosphere from the solar wind due to the absence of a Venusian magnetic field. If the CO glow in the Venusian atmosphere is excited by the electrons in interplanetary plasma, this phenomenon can be considered an analogue of terrestrial auroras and the glow intensity must be dependent on the level of solar activity. Not one of the probable chemical reactions with the participation of CO releases energy adequate for excitation of the observed CO glow except for the direct reaction



with an energy release of 11.24 eV, equal to the energy of CO dissociation. [141]

#### SCATTERED LYMAN-ALPHA RADIATION AROUND VENUS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 14, No 5, 1976 pp 799-806

[Article by J. L. Bertaux, J. Blamont, A. I. Dzyubenko, V. G. Kurt, T. A. Mityakina, Ye. N. Mironova, N. N. Romanova and A. S. Smirnov, "Investigation of Scattered Lyman-Alpha Radiation in the Neighborhood of Venus"]

[Abstract] The "Venera-9" and "Venera-10" carried photometers for registering scattered UV radiation in the Lyman-alpha line. The instrumentation has already been described in detail in the literature. Preliminary processing of UV measurements in the  $L\alpha$  line near Venus made it possible to determine the density of atomic hydrogen in the upper atmosphere of Venus in the altitude region from 250 and to 5,500 km above the surface. The distribution is characterized by  $n = 10^5 \text{ cm}^{-3}$ ,  $T = 450 \pm 50^\circ\text{K}$  and  $h = 275 \text{ km}$  within the framework of the model published by J. Chamberlain in PLANET. SPACE SCI., 11, 1963, 901. It was found that the upper limit of the density of atomic deuterium in the Venusian exosphere does not exceed several percent relative to atomic hydrogen. In addition to these conclusions, the authors see a possibility of finding the distribution of emission in the lines of the triplet of atomic oxygen 1302, 1304 and 1305 Å. [141]

#### IMPROVED METHOD FOR DETERMINING COORDINATES OF ARTIFICIAL SATELLITES

Moscow ASTRONOMICHESKIY ZHURNAL in Russian, Vol 53, No 6, 1976 pp 1344-1346

[Article by B. A. Firago, Main Astronomical Observatory, "Determination of Coordinates of Artificial Earth Satellites Using Asynchronous Data"]

[Abstract] In so-called synchronous observations of artificial satellites from several stations by the satellite astrometry and chronometry method the result is essentially asynchronous directions to a satellite, but only at known precise moments in time (B. A. Firago, ASTRON. ZH., 46, 180, 1969). Subsequent synchronization of the results in time gives necessary material for the purposes of space triangulation. Since triangulation in itself is invariant relative to time, the author made an attempt to generalize the method of a beam of synchronous straight lines, applying it to the use of asynchronous directions (B. A. Firago, COSPAR TRANSACTIONS, No 7, 1970, 165). This new paper examines comparisons of use of synchronous, asynchronous and mixed data (general case) and also the possibility of applying these data in space triangulation. It is demonstrated that the accuracy in determining coordinates is better in the case of use of asynchronous data. Synchronous data can be used jointly with them and improved in the same way.

[163]

#### TRANSFER OF ENERGY OF INTERNAL WAVES TO MEAN FLOW

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 12, No 11, 1976 pp 1212-1214

[Article by N. M. Gavrilov, Leningrad State University, "Rate of Transfer of Energy of Internal Waves to Mean Flow in Upper Atmosphere"]

[Abstract] In shear flow acoustic-gravitational waves are capable of transmitting their energy to the background motion. For the upper atmosphere this effect has been illustrated by numerical computations for internal gravitational waves. Such evaluations, however, are highly dependent on a priori assumptions concerning the mechanisms of dissipation and reflection of acoustic-gravitational waves. The article cited above gives formulas for estimating the rate of transmission of  $\mathcal{E}$ , the energy of internal gravitational waves and tidal oscillations, to the background flow. The derived formulas are convenient in that they contain only the local characteristics of the waves and no knowledge of their vertical structure is required. At the end of the article the author gives  $\mathcal{E}$  estimates for the upper atmosphere. It is shown that internal gravitational waves and tidal oscillations exert an influence on restructuring of the mean wind field in the upper atmosphere. Some of the possible sources of internal gravitational waves in the upper atmosphere are strong dynamic disturbances, such as fronts, in the troposphere. The movements with synoptic scales observed in the upper atmosphere

are transmitted into the upper atmosphere by wave processes. The internal gravitational waves generated by electrojets during auroras can partially explain the appearance of thermospheric winds which correlate with geomagnetic disturbances. The energy exchange between the mean flow and waves can be regarded as an important mechanism for both the weakening and strengthening of internal gravitational waves and tidal oscillations in the upper atmosphere.

[134]

#### ORBITAL BEHAVIOR OF BALLOON SATELLITES UNDER INFLUENCE OF LIGHT PRESSURE

Moscow ASTRONOMICHSKIY ZHURNAL in Russian Vol 53, No 5, 1976 pp 1085-1094

[Article by S. N. Vashkov'yak, State Astronomical Institute, "Change in the Orbit of Balloon Satellites Under the Influence of Light Radiation"]

[Abstract] The author examines the influence of direct light pressure on the motion of artificial earth satellites. This effect must be taken into account in a study of the motion of some geodetic satellites, but especially balloon satellites characterized by a great ratio of cross section to mass. Light pressure results in a considerable change in the orbit of the balloon satellite, especially in periods when a part of the orbit is in the shadow and this in turn can be reflected in the lifetime of the satellite. In earlier studies by the author VESTN. MOSK. UN-TA, SER. FIZIKA, ASTRON., 5, 584, 1974; NABLYUDENIYA ISKUSSTVENNYKH SPUTNIKOV ZEMLI, No 13, 1973(1974); SOOBSHCH. GOS. ASTRON. IN-TA im. SHTERNBERGA, No 208-209, 1976 it was demonstrated that the shadow function can be represented in dependence on the orbital elements of the satellite and in the first approximation it is possible to obtain the secular and long-period perturbations in the motion of AES. In this article the author obtains the secular and long-period perturbations of satellite orbital elements with a higher accuracy. The paper then gives a comparison of the mentioned computed orbital parameters of some balloon satellites and observed data. In solving the problem, the following assumptions are made: 1) solar parallax is neglected; 2) the earth's orbit is considered circular; 3) the flux of solar radiation in the region of the earth's orbit is assumed to be constant and its change with a change in satellite altitude above the earth is not taken into account. In the solution all the expansions are given to an arbitrary degree of satellite orbital eccentricity. The observational data considered are those for the PAGEOS, ECHO 1 and ECHO 2 balloons.

[119]

## INTERPLANETARY BACKGROUND OF LOW-ENERGY CHARGED PARTICLES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 14, No 6, 1976 pp 852-856

[Article by N. V. Alekseyev, P. V. Vakulov, N. I. Vologdin, Yu. P. Gordeyev, Yu. I. Denisov, Yu. I. Logachev, N. F. Pisarenko, I. A. Savenko, L. B. Solov'yev, A. F. Titenkov and B. Ya. Shcherbovskiy, "Measurement of the Interplanetary Background of Low-Energy Charged Particles Aboard the 'Venera-9' and 'Venera-10' Stations"]

[Abstract] One of the purposes of the "Venera-9" and "Venera-10" stations was an investigation, along their trajectories, of the energy spectrum and nuclear composition of the background fluxes of charged particles in the low-energy range. The instrument developed for these purposes made it possible to carry out investigations in the range including the poorly studied low-energy region. The instrument consisted of two telescopes formed from silicon semiconductor detectors. A block diagram of the instrument serves as a basis for discussing its operating principle and individual components. A figure shows the results of measurement of protons and electrons during the first month of the "Venera-9" station. The distances between the station and the earth during this time varied from one to seven million kilometers. During the considered period (10 June-5 July 1975) there were two large increases in the intensity of low-energy protons and a number of weaker bursts. The structure of the large intensity increases for electrons for the most part duplicates the structure for proton intensity increases. Analysis of these increases shows that the protons make a substantial contribution to the events. A purely electron increase was observed only from the flare of 27 June 1975. For determining the background, fluxes of charged particles were determined when there were no significant increases in the particle fluxes. The mean energy spectrum of protons was determined for these time intervals. The background fluxes of electrons during this time in the energy ranges 50-100 and 100-300 keV were  $2.3 \pm 0.2 \cdot 10^{-2}$  and  $6.4 \pm 0.6 \cdot 10^{-3}$  particles/cm<sup>2</sup>·sec·sr·keV. The admixture of protons was insignificant and did not exceed 2%.

[168]

## COSMIC RAY MEASUREMENTS ABOARD "VENERA" VEHICLES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 14, No 6, 1976 pp 857-868

[Article by S. N. Vernov, B. A. Tverskoy, V. I. Volga, Ye. Ya. Volodin, N. G. Galach'yev, I. V. Getselev, Ye. V. Gorchakov, P. P. Ignat'yev, V. A. Iozenas, N. N. Kontor, G. P. Lyubimov, M. V. Ternovskaya, V. I. Tkachenko, Ye. A. Chuchkov, T. Ye. Shvidkovskaya and V. A. Yakovlev, "Measurement of Cosmic Rays Aboard the Automatic Interplanetary Stations 'Venera-9' and 'Venera-10'"]

[Abstract] The "Venera-9" and "Venera-10" were used in carrying out systematic measurements of the flux of charged particles in space. This has made it possible to trace the dependence of variations in the flux of cosmic particles on the degree of solar activity over a part of the twentieth solar 11-year cycle. This flight of the two vehicles was in a period of relatively low solar activity. During this period there were flares on the sun, for most part near the equator. Cosmic radiation was registered along the trajectory to Venus and in the orbits of Venusian satellites. Table 2 (eight pages in length) gives the counting rates for protons on the basis of "Venera-9" measurements; Table 3 is a relatively short table giving the counting rate for protons for the "Venera-10." The data show that the behavior of particles of different energies, specifically, for protons with  $E > 30$  and  $E > 800$  MeV, is essentially dissimilar. Modulation of the spectrum of galactic particles occurs virtually independently in different energy intervals, although the long-term intensity variation is most frequently synchronous. The indicated relationships of particle fluxes indicate that in the period near the solar activity minimum inhomogeneities of the interplanetary medium appear which result in substantial variations in the spectrum of galactic cosmic rays.

[168]

#### TELEVISION EXPERIMENT ON VENUSIAN SURFACE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 14, No 5, 1976 pp 674-677

[Article by A. S. Selivanov, V. P. Chemodanov, M. K. Narayeva, A. S. Panfilov, M. A. Gerasimov and I. I. Kobzeva, "Television Experiment on Venusian Surface"]

[Abstract] The television apparatus used on the descent modules of the "Venera-9" and "Venera-10" is described. A diagram of the television system is given and this serves as a basis for discussing the operating principle and technical specifications. The rate of transmission of information from the descent modules (256 bits/sec) and the nominal time of its existence on the surface (30 minutes) determined the principal scanning parameters, among which some were as follows: number of elements in line -- 115, number of lines in panorama --  $517 \pm 13$ , angular resolution --  $21'$ , time required for transmitting panorama --  $30 \pm 0.9$  minutes, time for transmitting line -- 3.5 sec, range of working illuminations -- 15-15,000 lux, weight -- 5.8 kg, consumed power -- 5 W. It was found that illumination on the Venusian surface at the subsolar point and in near regions is quite high and imposes no substantial limitations on ensuring television transmission even for low albedo values. The contrasts in relief elements are tens of percent; this considerably exceeds what was anticipated. These contrasts are caused by the slopes of relief elements and variations of the brightness coefficient.

[141]

## VENUSIAN INFRARED SPECTRUM

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 14, No 5, 1976 pp 758-767

[Article by V. I. Gnedykh, V. S. Zhegulev, L. V. Zasova, V. I. Moroz, N. A. Parfent'yev and G. V. Tomasheva, "Preliminary Results of Investigations of the Infrared Spectrum of Venus on the 'Venera-9' and 'Venera-10' Orbital Vehicles"]

[Abstract] On the "Venera-9" and "Venera-10" descent modules several methods were used in studying the cloud layer profile at great depths, beginning almost from the upper boundary. This paper gives a brief description of the spectrometer, examples of the measurements carried out with it under different conditions (different phase angles, center, limb, terminator) and a preliminary interpretation. The IR spectrometer is discussed in detail, accompanied by a diagram of its optical system. Among the parameters were the following: spectral range --  $1.6-2.8\mu\text{m}$ ; resolution  $\lambda/\Delta\lambda$  -- 20; angular resolution --  $0.0166 \times 0.0067$  rad; time for registering one spectrum -- 10 sec; range of measured intensities ( $\lambda 2\mu\text{m}$ ) --  $10^{-5}-5 \cdot 10^{-2} \text{W} \cdot \text{cm}^{-2} \cdot \mu\text{m}^{-1} \cdot \text{sr}^{-1}$ ; modulation frequency -- 200 Hz; time constant -- 0.1 sec; weight -- 4.6 kg; electric power consumed -- 5.6 W. Data were obtained with the IR spectrometer in approximately 20 sessions. The following conclusions were drawn: 1. The  $\text{CO}_2$  absorption bands near  $2\mu\text{m}$  are formed within the scattering cloud medium. The behavior of the absorption bands with a change in the phase angle and the center-limb effect correspond well to a model with scattering and do not agree with a simple reflection model. 2. The upper boundary of the cloud layer (determined as the level at which the concentration decreases by a factor of e) is situated at an altitude of 65-68 km. The vertical profile of the cloud layer is characterized by a scale height  $H_a \approx 3-5$  km. 4. The horizontal profile of the upper boundary at scales 50-100 km or more is very smooth: the variation of its altitude does not exceed 1-2 km. 5. Brightness in the continuous spectrum in the range  $2.2-2.4\mu\text{m}$  with respect to absolute value and angular dependences can be explained by a model of a semi-infinite atmosphere with  $a \approx 0.98$  and  $g \approx 0.7$  (a is the albedo of single scattering; g is a parameter characterizing the elongation of the indicatrix).

[141]

## PROBLEMS OF THE POLAR IONOSPHERE

Moscow REFERATIVNYY ZHURNAL, GEOFIZIKA, SVODNYY TOM in Russian No 9, 1976 9A19

[Abstract of article by A. S. Besprozvannaya and V. M. Driatskiy; Moscow, FIZ. IONOSFERY, 1976, pp 21-22, "Problems of the Polar Ionosphere"]

[Text] Analysis of modern information obtained using surface and in situ measurements made it possible to define a series of problems of a fundamental nature in investigations of the polar ionosphere which in general form can be formulated as the problem of magnetospheric-ionospheric interaction. It has been established that ionospheric-magnetospheric interaction takes place by means of an exchange of thermal plasma ( $\sim 1$  eV) between the ionosphere and magnetosphere, the leakage of high-energy particles from the magnetosphere ( $\sim 0.3$ – $100$  keV) and through the motion of ionospheric plasma under the influence of magnetospheric convection. There was found to be two principal sources of leaking particles: thermalized plasma of the transition layer of the magnetosphere, penetrating into the atmosphere of the high latitudes on the daytime side into the region of the polar cusp, and the "auroral" plasma from the tail of the magnetosphere. Injection of auroral plasma occurs on the nighttime side, after which the plasma is transported from the injection region due to electric and magnetic drifts. The transport of ionospheric plasma under the influence of the electric field of convection is interpreted in recent years as one of the important factors determining the state of the F region in the high latitudes. Two possible results of the horizontal transport are: change in chemical composition, and accordingly, a change in the rate of losses of charged particles or the transport of ionization across the polar cap from the daytime to the nighttime side.

[162]

#### ENERGY-MODULATION COEFFICIENT DEPENDENCE IN 11-YEAR CYCLE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 16, No 6, 1976 pp 960-969

[Article by A. K. Svirzhevskaya, Yu. I. Stozhkov and T. N. Charakhch'yan, Physics Institute and Nuclear Physics Institute, Moscow State University, "Energy Dependence of Modulation Coefficient in 11-Year Cycle of Galactic Cosmic Rays"]

[Abstract] The energy dependence of the modulation coefficient in the 11-year cycle of cosmic rays is studied on the basis of experimental data on changes in the intensity of cosmic rays in the stratosphere for different periods of the 19th and 20th solar activity cycles. The hardness range considered is 0.5–10 GV. A single gas-discharge counter was used. Presentation of the experimental data is followed by an examination of the dependence of the mean scattering path on particle hardness, an analysis of the spectrum of intensities of magnetic inhomogeneities and a detailed consideration of the anomalous effect in the spectrum of cosmic ray variations during 1969–1972. It is noted that there are periods of time when the combination of measurement data for the stratosphere and the ground surface cannot be described using a simple approximation of the modulation coefficient in the form:  $\psi = A/\beta(R+b)$ . During these periods the spectrum of

intensities of magnetic inhomogeneities cannot be represented in the form of a power law dependence. It is now possible to estimate the size, density and strength of magnetic inhomogeneities which were characteristic for the period 1972-1974. For inhomogeneities with  $\Lambda = V/f = 10^4 RV$  with  $R = 3$  GV one obtains  $\Lambda = 1.2 \cdot 10^{12}$  cm. The density of the magnetic inhomogeneities can be estimated using the relationship between the modulation coefficient and the parameters of the interplanetary medium.  
[144]

#### METHOD FOR DETERMINING $N(h)$ PROFILES FOR IONOSPHERE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 16, No 6, 1976 pp 1002-1008

[Article by N. P. Danilkin and V. V. Sotskiy, Rostov-on-Don State University, "Determination of  $N(h)$  Profiles in Ionosphere Using Data from Trans-ionospheric Sounding"]

[Abstract] The purpose of this study was a mathematical formulation of the problem of determining  $N(h)$  profiles in the ionosphere on the basis of data from transionospheric sounding. Transionograms are used in ascertaining the frequency dependences of the group lags of signals emitted from aboard an artificial earth satellite at frequencies greater than the maximum useable frequency and passing through the ionosphere. The uniqueness of solution of this problem in the class of monotonic profiles is shown; methods are proposed for determining  $N(h)$  profiles for different models of the ionosphere: plane isotropic, spherical isotropic and spherical nonisotropic. It is noted that in the case of slant probing of the ionosphere the group paths of the transionospheric signals contain information on the electron concentration function determined along the signal trajectory. In this case the model of the spherical ionosphere makes it possible to interpret the  $N(h)$  profiles as vertical ionization cross sections. However, it is clear that when there are great slants of the transionospheric trajectories the problem of determining  $N(h)$  profiles as vertical ionization cross sections loses sense because in this case the sounding ionogram gives information on the outer ionosphere several thousand kilometers distant from the reception station.  
[144]

#### CONTRAST OF NEGATIVE RELIEF FORMS ON VENUSIAN SURFACE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 14, No 5, 1976 pp 687-690

[Article by A. S. Panfilov and A. I. Goron, "Evaluation of the Contrasts of Some Negative Relief Forms on the Venusian Surface"]

[Abstract] In earlier articles (KOSMICH. ISSLED., 13, No 4, 612, 1975, and elsewhere) the author computed the contrasts on the Venusian surface for an object having a stepped structure -- a slope with a variable degree of slope with horizontal surfaces at the top and bottom. It is natural to expect greater contrasts for negative relief forms. The paper cited above gives computations for two similar relief types: an elongated trough having a triangular cross section and a crater. The Venusian surface is assumed to be orthotropic and therefore the contrast is determined as

$$K = (E_{\max} - E_{\min})/E_{\max}, \quad (1)$$

where  $E_{\max}$ ,  $E_{\min}$  are the maximum and minimum illuminations of the surface. Direct solar radiation does not reach the surface; it is illuminated by scattered radiation. The brightness of the Venusian heavens is not dependent on azimuth and is a function of the zenith distance of the radiating point and surface albedo

$$B = a(b+c \cos \vartheta), \quad (2)$$

where  $a$  is a constant value for fixed values of solar zenith distance and surface albedo and  $a$  scattering function averaged for the entire thickness of the atmosphere. On this basis, analyzing the special cases of the noted negative relief forms, it is concluded that the contrasts for them are commensurable to or greater than for a stepped object. It is noted that in solving the problems in this paper the authors used only one characteristic of Venus, that given by expression (2). But it is correct for any surface situated at a great optical depth in a conservatively scattering medium. Accordingly, the results can find broader application than only in a survey of the Venusian surface.

[141]

#### AUTOMATIC DETERMINATION-DETECTION OF COLLIMATING MARKS ON PHOTOGRAPHS

Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 10, 1976 pp 37-42

[Article by L. P. Yaroslavskiy, "Algorithms for Automatic Detection and Determination of Collimating Marks on Aerial and Space Photographs"]

[Abstract] This paper describes an algorithm for the automatic detection of collimating marks on aerial and space photographs by use of an electronic computer and the results of its checking on a test aerial photograph and photographs from the "Mars-4" space station. The algorithm was used in processing photographs transmitted from the "Mars-4" and "Mars-5" for detecting collimating marks (crosses) and also small defects and spots present on some photographs. This algorithm is quite universal and it can be used for automatic determination of the coordinates of the corresponding points on aerial and space photographs in the process of automated processing by

the stereophotogrammetric method. The author describes a correlation detector, a variety of a linear detector, in which the solution of the problem of presence of the sought-for object and its coordinates is adopted in dependence on signal strength at the output of some linear filter acting on the observed image. The optimum form of this filter is found. Figure 2 in the text is a block diagram of the process of detection and discrimination of the collimating marks; this serves as the basis for the discussion. Figures 3, 4, 5 illustrate the results of processing of photographs of Mars with use of the described algorithm.

[166]

## VI. MISCELLANEOUS

### News

#### WORK OF LABORATORIES AT ARCTIC AND ANTARCTIC INSTITUTE

Moscow IZVESTIYA in Russian 11 Dec 76 p 6

[Article by A. Viktorov; "The Arctic at Fontanka"]

[Summary] The ice research laboratory is the coldest place at the Arctic and Antarctic Institute. Here there is complete simulation of the severe polar conditions: the waters of the basin are covered with a solid ice crust and scientists work in warm fur clothing, because after all the experiments are carried out at a temperature of  $-30^{\circ}$ . The efforts of the laboratory workers headed by Candidate of Geographical Sciences V. Panov are directed to discovery of the laws and properties of ice, their influence on hydroengineering structures. Panov states that among other studies, a series of experiments is being carried out to clarify the peculiarities of the process of icing of fishing ships and developing measures for contending with these phenomena, sometimes leading to the destruction of vessels. A special monograph published this year by the Gidrometeoizdat, entitled OBLEDENENIYE SUDOV (Icing of Ships), contains the generalized results of many years of work. The laboratory of ice qualities of ships is headed by the well-known polar specialist Candidate of Technical Sciences D. Maksutov. In the ice basin here specialists are testing models of future icebreakers and also transport ships of the ice class. They are investigating the problems involved in ice resistance during movement. The collected data are sent to planners. Shipbuilders at Wismar (GDR) are among those who use this information. In one of the laboratory rooms there is a microclimate chamber which is called the "medical" chamber. In this chamber, under the direction of Doctor of Medical Sciences A. L. Matusov, interesting experiments have been carried out for several years to determine the thermal state of man under different climatic conditions. Men in special heat-insulating clothing occupy the chamber in which the temperature attains  $-40^{\circ}$  and a wind of great force is artificially created. Such experiments are also made directly under polar conditions. More than 2,000 questionnaires have been distributed and these have made possible an approach to solution of the problem of

what type of clothing is best for polar workers. In 1977 standard production will begin on a new type of clothing in which a wind-impermeable film is enclosed between the inner and outer layers.

[170]

#### SPECIAL DRILLING APPARATUS PIERCES ANTARCTIC ICE SHELF

Moscow IZVESTIYA in Russian 16 Dec 76 p 6

[Article by A. Viktorov: "Ice Dome of the Antarctic Has Been Pierced"]

[Summary] On the extensive ice shelf in the neighborhood of Novolazarevskaya station Soviet scientists for the first time have used a specially designed electrothermal corer for drilling through the ice shelf. The leader of the 22d Soviet Antarctic Expedition, L. Dubrovin, provided the following information on this event. The ice shelf occupies more than 1 1/2 million square kilometers, about 11% of the entire Antarctic continent, and therefore its study is very important. At the Arctic and Antarctic Institute, under the direction of engineer V. Morev, specialists have developed this electrothermal corer which makes it possible to drill a borehole 110 mm in diameter at a rate up to 6 m/hour. For rapid drilling of boreholes with a small diameter an electrothermal needle was also developed; the rate of drilling of this instrument is 20 m/hour. The drilling apparatus is convenient for transport. It is mounted on sledges which can be transported by helicopter or moved overland. Soviet polar workers under the direction of Candidate of Geographical Sciences L. Savtyugin drilled a borehole with a depth of 357 m near Novolazarevskaya at a distance of 35 km from the outer shore line. Under the ice shelf there was found to be a 200-m layer of sea water. A ground sample was taken from the bottom. A second borehole has now been drilled on the ice shelf at a distance of approximately 50 km from the shore of the Lazarev Sea. The thickness of the ice cover here is 447 meters and the layer of sea water beneath it is 40 m. In Leningrad, at the Institute of Arctic Geology, a core taken from the sea floor beneath the ice shelf was subjected to a careful analysis. It was found that the composition of the diatomaceous algae from the floor of this water body has not undergone changes during the last 10,000 years. The water temperature here is -1.5-1.9°. With respect to water salinity, it is approximately the same as in the open ocean. This type of work is affording possibilities for a thorough study of the hydrological regime and structure of the sea waters beneath the shelf, their biology and bottom geology.

[183]

#### "BASHKIRIYA" UNDER WAY TO THE ANTARCTIC

Moscow PRAVDA in Russian 29 Nov 76 p 4

[Article by V. Bardin: "Six Thousand Miles are Behind"]

[Text] On its journey to the ice continent the "Bashkiriya," a ship of the 22d Soviet Antarctic Expedition, has traveled more than six thousand miles from the shores of its homeland. During a brief stop at the picturesque island of Mauritius, which is located in the tropical latitudes of the Indian Ocean, potatoes, onions, tomatoes, melons, bananas, oranges and other fruits were loaded aboard the motor ship. Soon these fresh fruits and vegetables will grace the tables of polar scientists at Soviet Antarctic stations.

When the Tropic of Capricorn was left behind the heat began to decline. It got cooler and cooler on deck. On the clear nights there could be seen ahead along the course the famous constellation called the Southern Cross. Ursa Major, the usual constellation of the Northern Hemisphere, dropped below the horizon. The ship had entered the waters of the Southern Ocean. The crew prepared well in advance for a possible worsening of the weather. Worries increased for Captain K. Loskutov, Senior Assistant S. Rodin and boatswain A. Kopeyka. Sailing in these waters requires special caution. The latitudes here were named the "roaring forties" and the "furious fifties" for good reason. From days of old they have had a bad reputation among sailors. Storm winds, thick fogs and encounters with icebergs complicate the vessel's movement toward its goal.

The "Bashkiriya" is maintaining a course to the Kerguelen Archipelago where, if the weather is favorable, it will attempt to renew its supply of fresh water. Although world supplies of fresh water (about 80%) are basically concentrated in the ice of the Antarctic continent, water in its usual form is a rarity in the Antarctic and ships are often unable to fill their tanks at the shores of the sixth continent.

Time passes quickly during the voyage. In the mornings various kinds of professional training goes on. The personnel of the individual stations discuss their problems. In the evenings the expedition members gather to hear lectures and share their experience in polar research. Thus, the director of the cruise, Yu. Zusman, discussed the history of the conquest of the Antarctic. The glaciologist, Doctor of Technical Sciences K. Votkovskiy, gave a lecture on an unusual topic: "ice and snow as building materials."

In general, everything aboard the ship goes on with its own rhythm. Of course there are also unplanned events. Geophysicist V. Zhivov received the joyful news from Leningrad that his daughter had just been born. She was named Victoria. The meaning of the name is "victory," a thing needful to all who have devoted themselves to the study of the fiercest region of our planet.

[4]

5303

-END-

CSO: 1866